TENNENT'S NAUTICAL ALMANAC FOR THE PACIFIC COAST.

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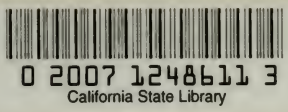

PRICE

TENNENT'S

# Nautical Almanac

## TIDE REGISTER

FOR

THE PACIFIC COAST,

AND

# MARINE DIGEST,

FOR

# 1877.

By THOMAS TENNENT,

CHRONOMETER, WATCH AND NAUTICAL INSTRUMENT MAKER.

DEPOT FOR U. S. GOVERNMENT CHRONOMETERS,

SAN FRANCISCO.

# PACIFIC

# MAIL STEAMSHIP CO

The steamships of this Company will sail FROM SAN FRAN CISCO, during the year 1877, as follows:

**FROM WHARF, CORNER FIRST AND BRANNAN STREETS.**

***HOUR OF DEPARTURE, 12 NOON.***

## FOR YOKOHAMA AND HONGKONG,

On the 1st of every month, connecting at Yokohama with th steamers of the MITSU BISHI Co. for HIOGO, NAGASAK and SHANGHAI.

## FOR SYDNEY AND AUKLAND, VIA HONOLULU,

| | | | |
|---|---|---|---|
| January 3. | March 28. | June 20. | September 12. |
| January 31. | April 25. | July 18. | October 10. |
| Feb'ry 28. | May 23. | Aug. 15. | November 7. |
| | | | December 5. |

## FOR NEW YORK AND PANAMA,

Taking passengers and freight for Mexican, Central American and South American Ports; for Liverpool, London, an Southampton; for St. Nazaire, and for Hamburg, Bremer and Antwerp.

## FOR VICTORIA, B. C., PORT TOWNSEND, SEATTLE, TACOMA, OLYMPIA, AND PORTLAND,

On the 10th, 20th, and 30th of every month.

NOTE.—April 1 and July 1 coming on Sunday, the China steamer will sail April and July 2.

NOTE.—Sept. 16 and 30 and Dec. 16 and 30 coming on Sunday, the Panama steamer for those dates will sail Sept. 15 and 29 and December 15 and 29.

NOTE.—May 20, June 10, Sept. 30, and Dec. 30 coming on Sunday, the Victoria an Puget Sound steamer will sail May 19, June 9, Sept. 29, and Dec. 29.

**WILLIAMS, BLANCHARD & CO., AGENTS.**

SAN FRANCISCO, January 1, 1877.

TENNENT'S

# Nautical Almanac

## TIDE REGISTER

FOR

THE PACIFIC COAST,

AND

# MARINE DIGEST,

FOR

# 1877.

By THOMAS TENNENT,

CHRONOMETER, WATCH AND NAUTICAL INSTRUMENT MAKER.

DEPOT FOR U. S. GOVERNMENT CHRONOMETERS,

SAN FRANCISCO.

P. O. Box 1036.
JOHN ROACH,
OPTICIAN,
S. W. Corner Sacramento and Montgomery Sts.,
San Francisco, Cal.

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BY THOMAS TENNENT,

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409 Washington Street.

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# THIRTEENTH YEAR OF PUBLICATION.

This work was first issued in 1864, in an edition of two hundred copies, simply as a Tide Table for the Port of San Francisco. Meeting with rapid sale, the book has been enlarged each succeeding year, and its circulation has so increased that it now requires an edition of fifteen hundred copies to meet the demand. It contains the time of the two high waters for each day in the year for the ports of San Francisco, San Diego, Astoria, and Port Townsend, together with Tables of Tidal Constants, by means of which the time of high water can be found for each day at fifty-six other points in San Francisco Bay and on the coast between San Diego and Puget Sound. These Tide Tables are from data derived from seven years' additional records of the various Tide Gauges specially furnished to me by the United States Coast Survey Office at Washington, D. C., and will be found correct, the critical test applied by so many navigators during the past thirteen years having proved their accuracy and reliability.

The book also contains full and complete Sailing Directions for approaching and entering the harbor of San Francisco; all the Harbor Laws and Sanitary Regulations; the Sun's Right Ascension, Declination, and Equation of Time, with hourly differences; a complete list of all the Light-houses now erected on the coast; all the Fog Signals now in operation; notices of all newly discovered rocks and dangers on the coast and in the Pacific Ocean generally; together with new and selected extracts, examples in working time, and many other matters of interest to the navigator, which are more fully set forth in the Table of Contents on the next page.

The Table of Rain-fall in this city, arranged in months and seasons, giving the quantity of rain and the number of rainy days from the season of 1849–50 to that of 1875–76 inclusive, is from records kept by me during that period, and although somewhat foreign to the character of this work, yet, never having before been published continuously, will be of interest to many, especially to those interested in our grain crops.

In the present edition I have inserted an important Rule and Table, by means of which the time of low water can be readily found for any day in the year, and for any point on the coast; also, a Table showing for every tenth day in the year, in San Francisco mean time, the Upper and Lower Meridian Passages, and also the greatest Eastern and Western Elongations of the Pole Star. This will be of great service to navigators in observing for latitude or azimuth, and also to surveyors and engineers in finding the variations of the compass.

Succeeding editions will be enlarged as may be required, and no pains will be spared to make the work, as heretofore, indispenable to shipmasters employed on this coast, and very convenient to all others.

THOMAS TENNENT.

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# ECLIPSES IN 1877.

In 1877 there will be five Eclipses, three of the Sun and two of the Moon.

I. A total Eclipse of the Moon, February 27th. Invisible at San Francisco.

II. A partial Eclipse of the Sun, March 14th. Visible in the north-western part of Asia and the Arctic Ocean.

Begins on the Earth, March 14th, 8 hours 7 min. mean time at Washington, in longitude 151 deg. 59 min. East from Washington, and in latitude 34 deg. 7 min. North.

Greatest Eclipse, 9 hours 30 min. in longitude 133 deg. 38 min. East from Washington, and in latitude 64 deg. 4 min. North.

Eclipse ends on the Earth, 10 hours 52 min. in longitude 156 deg. 23 min. East from Washington, and in latitude 87 deg. 9 min. North.

III. A partial Eclipse of the Sun, August 8th. Visible in north-eastern Asia, north-western America, and Polar Sea.

Begins on the Earth, August 8th at 11 hours 4 min. mean time at Washington, in longitude 46 deg. 48 min. West from Washington, and in latitude 72 deg. 56 min. North.

Greatest Eclipse, 12 hours 22 min. in longitude 146 deg. 33 min. West from Washington, and in latitude 62 deg. 22 min. North.

Eclipse ends on the Earth, 13 hours 40 min. in longitude 172 deg. 50 min. East from Washington, and in latitude 35 deg. 48 min. North.

IV. A total Eclipse of the Moon, August 23d. Invisible at San Francisco.

V. A partial Eclipse of the Sun, September 6th. Visible in the southern portion of South America and South Atlantic Ocean.

Begins on the Earth, September 6th at 18 hours 2 min. mean time at Washington, in longitude 1 deg. 34 min. East from Washington, and in latitude 23 deg. 12 min. South.

Greatest Eclipse, 19 hours 40 min. in longitude 14 deg. 44 min. West from Washington, and in latitude 61 deg. 14 min. South.

Eclipse ends on the Earth, 21 hours 18 min. in longitude 100 deg. 5 min. East from Washington, and in latitude 78 deg. 18 min. South.

## Morning and Evening Stars.

Venus will be Morning Star to May 9th, then Evening Star the rest of the year.
Mars will be Morning Star to May 6th, then Evening Star the rest of the year.
Jupiter will be Morning Star to March 24th, then Evening Star the rest of the year.
Saturn will be Evening Star to March 4th, then Morning Star to June 12th, then Evening Star the rest of the year.

# JANUARY, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Large. | Small. | Large. | Small. | Large. | Small. | Large. | Small. |
| | | P.M. | A.M. | A.M. | A.M. | P.M. | A.M. | A.M. | P.M. |
| Mon..... | 1 | 0 36 | 2 09 | 9 45 | 0 15 | 1 38 | 2 34 | 7 25 | 3 32 |
| Tues..... | 2 | 1 25 | 2 49 | 10 30 | 0 38 | 2 26 | 3 17 | 7 50 | 4 37 |
| Wed..... | 3 | 2 19 | 3 25 | 11 24 | 1 10 | 3 15 | 3 48 | 8 08 | 5 52 |
| Thur..... | 4 | small | large | small | large | small | large | 8 26 | 7 21 |
| Frid..... | 5 | 4 33 | 4 42 | P.M. | 2 25 | 5 11 | 4 50 | 8 53 | 8 48 |
| Sat..... | 6 | 5 50 | 5 26 | 2 30 | 3 15 | 6 21 | 5 38 | 9 25 | 10 17 |
| **Sun**..... | 7 | 7 02 | 6 10 | 4 24 | 4 00 | 7 30 | 6 36 | 9 56 | 11 44 |
| Mon..... | 8 | 8 17 | 6 53 | 6 30 | 4 50 | 8 42 | 7 33 | 10 54 | A.M. |
| Tues..... | 9 | 9 28 | 7 41 | 8 00 | 5 41 | 9 49 | 8 29 | 11 14 | 1 08 |
| Wed..... | 10 | 10 34 | 8 29 | 9 50 | 6 30 | 10 50 | 9 22 | 11 52 | 2 41 |
| Thur..... | 11 | 11 29 | 9 18 | 9 40 | 7 15 | 11 45 | 10 13 | P.M. | 3 58 |
| Frid..... | 12 | A.M. | 10 04 | 10 15 | 7 50 | A.M. | 11 02 | small | large |
| Sat..... | 13 | 0 16 | 10 46 | 10 50 | 8 30 | 0 36 | 11 48 | 1 43 | 5 40 |
| **Sun**..... | 14 | 0 53 | 11 22 | 11 18 | 9 05 | 1 21 | P.M. | 2 21 | 6 17 |
| Mon..... | 15 | 1 27 | 11 55 | 11 44 | 9 35 | 2 02 | 1 04 | 2 59 | 6 49 |
| Tues..... | 16 | 2 04 | P.M. | A.M. | 10 06 | 2 41 | 1 42 | 3 44 | 7 15 |
| Wed..... | 17 | 2 31 | 1 19 | 0 10 | 10 43 | 2 56 | 2 17 | 4 44 | 7 27 |
| Thur..... | 18 | large | small | large | small | large | small | 5 46 | 7 34 |
| Frid..... | 19 | 3 10 | 2 50 | 1 10 | P.M. | 3 41 | 3 39 | 6 48 | 7 40 |
| Sat..... | 20 | 3 48 | 3 54 | 1 40 | 1 05 | 4 14 | 4 30 | 8 00 | 7 53 |
| **Sun**..... | 21 | 4 22 | 4 59 | 2 21 | 2 11 | 4 50 | 5 27 | 9 20 | 8 15 |
| Mon..... | 22 | 5 08 | 6 08 | 3 06 | 3 55 | 5 34 | 6 29 | 10 51 | 8 46 |
| Tues..... | 23 | 5 46 | 7 20 | 4 00 | 5 57 | 6 22 | 7 36 | A.M. | 9 23 |
| Wed..... | 24 | 6 44 | 8 28 | 4 55 | 7 20 | 7 21 | 8 51 | 0 24 | 10 04 |
| Thur..... | 25 | 7 43 | 10 02 | 5 50 | 8 15 | 8 28 | 10 11 | 2 00 | 10 47 |
| Frid..... | 26 | 8 45 | 11 19 | 6 48 | 9 12 | 9 37 | 11 31 | large | small |
| Sat..... | 27 | 9 49 | A.M. | 7 45 | 10 00 | 10 43 | A.M. | 4 30 | P.M. |
| Sun..... | 28 | 10 47 | 0 17 | 8 30 | 10 48 | 11 45 | 0 36 | 5 37 | 1 34 |
| Mon..... | 29 | 11 38 | 1 01 | 9 15 | 11 25 | P.M. | 1 31 | 6 13 | 2 41 |
| Tues..... | 30 | P.M. | 1 39 | 10 10 | P.M. | 1 30 | 2 25 | 6 31 | 3 58 |
| Wed..... | 31 | 1 10 | 2 10 | 11 10 | 0 01 | 2 13 | 2 46 | 6 47 | 5 11 |

# JANUARY, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour | Equation of Time, to be *added* to Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 7 18 | 4 50 | 7 37 | 18 48 59 | 11.0 | S. 22 58 47 | 12.9 | 4 0.3 | 1.17 |
| 2 | 7 18 | 4 51 | 8 53 | 18 53 23 | 11.0 | 22 53 24 | 14.0 | 4 28.3 | 1.16 |
| 3 | 7 18 | 4 51 | 10 04 | 18 57 47 | 11.0 | 22 47 33 | 15.2 | 4 55.9 | 1.14 |
| 4 | 7 18 | 4 52 | 11 14 | 19 2 11 | 11.0 | 22 41 15 | 16.3 | 5 23.2 | 1.13 |
| 5 | 7 18 | 4 52 | morn | 19 6 35 | 11.0 | 22 34 30 | 17.4 | 5 50.1 | 1.11 |
| 6 | 7 18 | 4 53 | 0 19 | 19 10 58 | 11.0 | 22 27 18 | 18.5 | 6 16.5 | 1.09 |
| 7 | 7 18 | 4 54 | 1 25 | 19 15 21 | 10.9 | 22 19 40 | 19.6 | 6 42.4 | 1.07 |
| 8 | 7 18 | 4 55 | 2 29 | 19 19 43 | 10.9 | 22 11 35 | 20.7 | 7 7.9 | 1.05 |
| 9 | 7 18 | 4 56 | 3 32 | 19 24 4 | 10.9 | 22 3 4 | 21.8 | 7 32.9 | 1.03 |
| 10 | 7 18 | 4 57 | 4 33 | 19 28 25 | 10.9 | 21 54 7 | 22.9 | 7 57.3 | 1.00 |
| 11 | 7 17 | 4 58 | 5 30 | 19 32 46 | 10.8 | 21 44 45 | 24.0 | 8 21.1 | 0.98 |
| 12 | 7 17 | 5 59 | 6 23 | 19 37 6 | 10.8 | 21 34 57 | 25.0 | 8 44.3 | 0.96 |
| 13 | 7 17 | 5 00 | sets | 19 41 25 | 10.8 | 21 24 44 | 26.0 | 9 7.0 | 0.93 |
| 14 | 7 17 | 5 01 | 5 05 | 19 45 43 | 10.8 | 21 14 6 | 27.1 | 9 28.9 | 0.90 |
| 15 | 7 17 | 5 03 | 6 05 | 19 50 1 | 10.7 | 21 3 3 | 28.1 | 9 50.2 | 0.87 |
| 16 | 7 16 | 5 04 | 7 07 | 19 54 19 | 10.7 | 20 51 37 | 29.1 | 10 10.9 | 0.84 |
| 17 | 7 16 | 5 05 | 8 06 | 19 58 35 | 10.7 | 20 39 47 | 30.1 | 10 30.8 | 0.81 |
| 18 | 7 15 | 5 06 | 9 05 | 20 2 51 | 10.6 | 20 27 33 | 31.1 | 10 49.9 | 0.78 |
| 19 | 7 15 | 5 07 | 10 04 | 20 7 6 | 10.6 | 20 14 56 | 32.0 | 11 8.4 | 0.75 |
| 20 | 7 14 | 5 08 | 11 03 | 20 11 20 | 10.6 | 20 1 56 | 32.9 | 11 26.0 | 0.72 |
| 21 | 7 14 | 5 09 | morn | 20 15 34 | 10.5 | 19 48 34 | 33.9 | 11 42.9 | 0.69 |
| 22 | 7 13 | 5 10 | 0 04 | 20 19 46 | 10.5 | 19 34 50 | 34.8 | 11 59.0 | 0.65 |
| 23 | 7 12 | 5 11 | 1 08 | 20 23 58 | 10.5 | 19 20 45 | 35.7 | 12 14.2 | 0.62 |
| 24 | 7 11 | 5 13 | 2 16 | 20 28 9 | 10.4 | 19 6 18 | 36.6 | 12 28.7 | 0.59 |
| 25 | 7 11 | 5 14 | 3 25 | 20 32 19 | 10.4 | 18 51 30 | 37.4 | 12 42.4 | 0.55 |
| 26 | 7 10 | 5 15 | 4 36 | 20 36 29 | 10.4 | 18 36 21 | 38 3 | 12 55.2 | 0.52 |
| 27 | 7 09 | 5 16 | 5 37 | 20 40 37 | 10.3 | 18 20 53 | 39.1 | 13 7.2 | 0.48 |
| 28 | 7 09 | 5 17 | rises | 20 44 45 | 10.3 | 18 5 5 | 39.9 | 13 18.4 | 0.45 |
| 29 | 7 08 | 5 18 | 6 24 | 20 48 52 | 10.3 | 17 48 57 | 40.7 | 13 28.8 | 0.41 |
| 30 | 7 07 | 5 29 | 7 42 | 20 52 58 | 10.2 | 17 32 30 | 41.5 | 13 38.3 | 0.38 |
| 31 | 7 06 | 5 20 | 8 54 | 20 57 4 | 10.2 | 17 15 45 | 42.3 | 13 47.0 | 0.35 |

# FEBRUARY, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Small. | Large. | Small. | Large. | Small. | Large. | Large. | Small. |
| | | P.M. | A.M. | A.M. | A.M. | P.M. | A.M. | A.M. | P.M. |
| Thur..... | 1 | 2 06 | 2 35 | 11 46 | 0 23 | 2 56 | 3 24 | 7 01 | 6 24 |
| Frid .... | 2 | 3 09 | 3 01 | P.M. | 0 48 | 3 50 | 3 40 | 7 12 | 7 33 |
| Sat..... | 3 | 4 23 | 3 36 | 1 15 | 1 15 | 4 52 | 4 11 | 7 33 | 8 51 |
| Sun..... | 4 | 5 36 | 4 19 | 2 33 | 2 00 | 5 56 | 4 50 | 8 07 | 10 20 |
| Mon..... | 5 | 6 51 | 5 10 | 4 15 | 2 49 | 7 02 | 5 40 | 8 44 | 11 52 |
| Tues..... | 6 | 8 02 | 6 05 | 6 12 | 3 48 | 8 11 | 6 44 | 9 26 | A.M. |
| Wed. .... | 7 | 9 15 | 6 58 | 8 09 | 5 00 | 9 29 | 7 47 | 10 09 | 1 27 |
| Thur..... | 8 | 10 32 | 7 53 | 9 11 | 6 05 | 10 27 | 8 47 | small | large |
| Frid..... | 9 | 11 27 | 8 47 | 9 48 | 7 00 | 11 29 | 9 44 | 11 34 | 3 52 |
| Sat..... | 10 | A.M. | 9 39 | 10 12 | 7 48 | A.M. | 10 38 | P.M. | 4 35 |
| Sun..... | 11 | 0 01 | 10 34 | 10 30 | 8 11 | 0 17 | 11 26 | 1 08 | 5 02 |
| Mon..... | 12 | 0 46 | 11 05 | 10 47 | 8 56 | 0 58 | P.M. | 2 08 | 5 23 |
| Tues..... | 13 | 1 00 | 11 44 | 11 06 | 9 12 | 1 31 | 0 52 | 3 10 | 5 43 |
| Wed..... | 14 | 1 18 | P.M. | 11 25 | 9 51 | 1 54 | 1 27 | 4 12 | 5 59 |
| Thur..... | 15 | large | small | large | small | large | small | 5 12 | 6 10 |
| Frid..... | 16 | 1 54 | 1 47 | A.M. | 10 58 | 2 37 | 2 40 | 6 12 | 6 18 |
| Sat..... | 17 | 2 10 | 2 33 | 0 03 | 11 36 | 2 55 | 3 17 | 7 14 | 6 28 |
| Sun..... | 18 | 2 42 | 3 27 | 0 30 | P.M. | 3 26 | 4 04 | 8 16 | 6 36 |
| Mon..... | 19 | 3 25 | 4 37 | 1 02 | 1 46 | 4 05 | 5 01 | 9 31 | 6 50 |
| Tues..... | 20 | 4 10 | 5 52 | 1 38 | 3 25 | 4 50 | 6 08 | 10 54 | 7 24 |
| Wed..... | 21 | 5 03 | 7 15 | 2 34 | 5 27 | 5 45 | 7 21 | A.M. | 8 05 |
| Thur.... | 22 | 6 05 | 8 38 | 3 48 | 7 12 | 6 49 | 8 39 | 0 26 | 9 00 |
| Frid..... | 23 | 7 15 | 9 56 | 5 15 | 8 20 | 8 03 | 9 59 | large | small |
| Sat..... | 24 | 8 28 | 11 02 | 6 27 | 9 00 | 9 20 | 11 15 | 3 16 | 11 20 |
| Sun..... | 25 | 9 38 | 11 53 | 7 37 | 9 30 | 10 33 | A.M. | 4 13 | P.M. |
| Mon..... | 26 | 10 36 | A.M. | 8 34 | 10 00 | 11 33 | 0 15 | 4 48 | 1 46 |
| Tues..... | 27 | 11 37 | 0 30 | 9 15 | 10 29 | P.M. | 1 05 | 4 57 | 3 00 |
| Wed..... | 28 | P.M. | 0 58 | 10 00 | 10 50 | 1 17 | 1 40 | 5 25 | 4 13 |

# FEBRUARY, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *added* to Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 7 06 | 5 22 | 9 45 | 21 1 8 | 10.2 | S. 16 58 41 | 43.0 | 13 55.0 | 0.31 |
| 2 | 7 05 | 5 23 | 11 12 | 21 5 12 | 10.1 | 16 41 20 | 43.8 | 14 2.1 | 0.28 |
| 3 | 7 04 | 5 24 | morn | 21 9 15 | 10.1 | 16 23 41 | 44.5 | 14 8.4 | 0.25 |
| 4 | 7 03 | 5 25 | 0 18 | 21 13 17 | 10.1 | 16 5 45 | 45.2 | 14 13.9 | 0.21 |
| 5 | 7 02 | 5 26 | 1 23 | 21 17 18 | 10.0 | 15 47 32 | 45.9 | 14 18.6 | 0.18 |
| 6 | 7 01 | 5 27 | 2 25 | 21 21 19 | 10.0 | 15 29 3 | 46.5 | 14 22.5 | 0.15 |
| 7 | 7 00 | 5 28 | 3 25 | 21 25 18 | 10.0 | 15 10 18 | 47.2 | 14 25.6 | 0.11 |
| 8 | 6 59 | 5 29 | 4 19 | 21 29 17 | 9.9 | 14 51 18 | 47.8 | 14 28.0 | 0.08 |
| 9 | 6 58 | 5 30 | 5 07 | 21 33 15 | 9.9 | 14 32 2 | 48.4 | 14 29.5 | 0.05 |
| 10 | 6 57 | 5 31 | 5 47 | 21 37 13 | 9.9 | 14 12 32 | 49.0 | 14 30.3 | 0.02 |
| 11 | 6 56 | 5 32 | 6 22 | 21 41 9 | 9.8 | 13 52 48 | 49.6 | 14 30.3 | 0.01 |
| 12 | 6 55 | 5 33 | sets | 21 45 5 | 9.8 | 13 32 50 | 50.2 | 14 29.6 | 0.05 |
| 13 | 6 54 | 5 34 | 6 00 | 21 49 0 | 9.8 | 13 12 39 | 50.7 | 14 28.1 | 0.08 |
| 14 | 6 53 | 5 35 | 6 58 | 21 52 54 | 9.7 | 12 52 14 | 51.3 | 14 25.9 | 0.11 |
| 15 | 6 51 | 5 37 | 7 58 | 21 56 48 | 9.7 | 12 31 38 | 51.8 | 14 22.9 | 0.14 |
| 16 | 6 49 | 5 39 | 8 57 | 22 0 41 | 9.7 | 12 10 49 | 52.3 | 14 19.2 | 0.17 |
| 17 | 6 48 | 5 40 | 9 57 | 22 4 33 | 9.6 | 11 49 49 | 52.7 | 14 14.8 | 0.20 |
| 18 | 6 47 | 5 41 | 10 59 | 22 8 24 | 9.6 | 11 28 38 | 53 2 | 14 9.6 | 0.23 |
| 19 | 6 46 | 5 42 | morn | 22 12 15 | 9.6 | 11 7 16 | 53.6 | 14 3.8 | 0.26 |
| 20 | 6 45 | 5 43 | 0 06 | 22 16 5 | 9.6 | 10 45 44 | 54.0 | 13 57.2 | 0.29 |
| 21 | 6 44 | 5 44 | 1 12 | 22 19 54 | 9.5 | 10 24 2 | 54.4 | 13 50.0 | 0.31 |
| 22 | 6 43 | 5 45 | 2 19 | 22 23 43 | 9.5 | 10 2 11 | 54.8 | 13 42.2 | 0.34 |
| 23 | 6 41 | 5 46 | 3 23 | 22 27 31 | 9.5 | 9 40 11 | 55.2 | 13 33.7 | 0.37 |
| 24 | 6 39 | 5 47 | 4 20 | 22 31 18 | 9.5 | 9 18 2 | 55.5 | 13 24.6 | 0.39 |
| 25 | 6 38 | 5 48 | 5 09 | 22 35 5 | 9.4 | 8 55 45 | 55.9 | 13 14.9 | 0.42 |
| 26 | 6 37 | 5 49 | 5 50 | 22 38 52 | 9.4 | 8 33 20 | 56.2 | 13 4.6 | 0.44 |
| 27 | 6 35 | 5 50 | 6 23 | 22 42 37 | 9.4 | 8 10 47 | 56.5 | 12 53.4 | 0.46 |
| 28 | 6 34 | 5 51 | rises | 22 46 22 | 9.4 | 7 48 7 | 56.8 | 12 42.3 | 0.48 |

# MARCH, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Small. | Large. | Small. | Large. | Small. | Large. | Large. | Small. |
| | | P.M. | A.M. | A.M. | P.M. | P.M. | A.M. | A.M. | P.M. |
| Thur. | 1 | 1 07 | 1 19 | 10 35 | 11 15 | 2 04 | 2 09 | 5 37 | 5 26 |
| Frid. | 2 | 2 01 | 1 40 | 11 15 | 11 50 | 2 49 | 2 35 | 5 54 | 6 39 |
| Sat. | 3 | 2 58 | 2 09 | P.M. | A.M. | 3 36 | 3 01 | 6 10 | 7 54 |
| **Sun.** | 4 | 4 03 | 2 41 | 1 20 | 0 30 | 4 30 | 3 29 | 6 29 | 9 12 |
| Mon. | 5 | 5 18 | 3 25 | 3 15 | 1 20 | 5 29 | 4 07 | 6 55 | 10 28 |
| Tues. | 6 | 6 36 | 4 18 | 5 35 | 2 05 | 6 38 | 5 02 | 7 23 | 11 49 |
| Wed. | 7 | 7 59 | 5 19 | 7 00 | 3 10 | 7 47 | 6 04 | 8 10 | A.M. |
| Thur. | 8 | 8 54 | 6 25 | 7 45 | 4 45 | 8 57 | 7 09 | small | large |
| Frid. | 9 | 9 50 | 7 24 | 8 12 | 6 05 | 10 02 | 8 12 | 10 12 | 2 18 |
| Sat. | 10 | 10 38 | 8 22 | 8 36 | 7 00 | 10 57 | 9 14 | 11 15 | 3 11 |
| **Sun.** | 11 | 11 16 | 9 12 | 9 00 | 7 30 | 11 42 | 10 10 | P.M. | 3 44 |
| Mon. | 12 | 11 53 | 9 58 | 9 20 | 8 00 | A.M. | 10 59 | 1 16 | 4 07 |
| Tues. | 13 | A.M. | 10 40 | 9 40 | 8 30 | 0 17 | 11 41 | 2 17 | 4 24 |
| Wed. | 14 | 0 08 | 11 31 | 10 00 | 9 00 | 0 46 | P.M. | 3 20 | 4 37 |
| Thur. | 15 | large | small | large | small | large | small | 4 11 | 4 50 |
| Frid. | 16 | 0 59 | P.M. | 10 36 | 10 05 | 1 33 | 1 42 | 5 26 | 5 01 |
| Sat. | 17 | 1 06 | 1 34 | 11 02 | 10 37 | 1 51 | 2 22 | 6 31 | 5 19 |
| **Sun.** | 18 | 1 27 | 2 27 | 11 30 | 11 15 | 2 15 | 3 05 | 7 39 | 5 31 |
| Mon. | 19 | 1 58 | 3 32 | 11 50 | P.M. | 2 46 | 3 53 | 8 49 | 5 42 |
| Tues. | 20 | 2 44 | 4 43 | A.M. | 2 12 | 3 24 | 4 48 | 10 05 | 6 01 |
| Wed. | 21 | 3 41 | 5 59 | 0 30 | 4 35 | 4 14 | 5 57 | 11 16 | 6 27 |
| Thur. | 22 | 4 44 | 7 18 | 1 50 | 5 55 | 5 16 | 7 12 | large | small |
| Frid. | 23 | 5 51 | 8 34 | 3 30 | 7 00 | 6 35 | 8 32 | A.M. | 8 25 |
| Sat. | 24 | 7 04 | 9 37 | 5 32 | 7 48 | 7 55 | 9 48 | 1 36 | 9 52 |
| **Sun.** | 25 | 8 18 | 10 31 | 7 00 | 8 25 | 9 11 | 10 53 | 2 34 | 11 20 |
| Mon. | 26 | 9 25 | 11 18 | 7 41 | 8 51 | 10 22 | 11 45 | 3 15 | P.M. |
| Tues. | 27 | 10 23 | 11 42 | 8 15 | 9 15 | 11 24 | A.M. | 3 44 | 2 12 |
| Wed. | 28 | small | large | small | large | small | large | 4 07 | 3 27 |
| Thur. | 29 | P.M. | A.M. | 9 30 | 10 00 | P.M. | 0 53 | 4 21 | 4 39 |
| Frid. | 30 | 0 58 | 0 35 | 10 10 | 10 30 | 1 55 | 1 20 | 4 36 | 5 51 |
| Sat. | 31 | 1 55 | 0 50 | 11 20 | 11 05 | 2 39 | 1 50 | 4 55 | 7 05 |

# MARCH, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *added* to Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 6 33 | 5 52 | 8 49 | 22 50 7 | 9.3 | S. 7 25 21 | 57.1 | 12 30.4 | 0.51 |
| 2 | 6 31 | 5 53 | 9 59 | 22 53 51 | 9.3 | 7 2 29 | 57.3 | 12 18.0 | 0.53 |
| 3 | 6 30 | 5 54 | 11 08 | 22 57 35 | 9.3 | 6 39 30 | 57.6 | 12 5.1 | 0.54 |
| 4 | 6 29 | 5 55 | morn | 23 1 18 | 9.3 | 6 16 25 | 57.8 | 11 51.8 | 0.56 |
| 5 | 6 28 | 5 56 | 0 13 | 23 5 1 | 9.3 | 5 53 16 | 58.0 | 11 38.0 | 0.58 |
| 6 | 6 26 | 5 57 | 1 15 | 23 8 43 | 9.3 | 5 30 1 | 58.2 | 11 23.8 | 0.60 |
| 7 | 6 24 | 5 58 | 2 13 | 23 12 25 | 9.2 | 5 6 42 | 58.4 | 11 9.3 | 0.61 |
| 8 | 6 23 | 5 59 | 3 02 | 23 16 6 | 9.2 | 4 43 19 | 58.5 | 10 54.3 | 0.63 |
| 9 | 6 22 | 6 00 | 3 46 | 23 19 48 | 9.2 | 4 19 52 | 58.7 | 10 39.0 | 0.64 |
| 10 | 6 20 | 6 01 | 4 23 | 23 23 29 | 9.2 | 3 56 22 | 58.8 | 10 23.4 | 0.66 |
| 11 | 6 18 | 6 02 | 4 54 | 23 27 9 | 9.2 | 3 32 48 | 58.9 | 10 7.5 | 0.67 |
| 12 | 6 16 | 6 03 | 5 21 | 23 30 49 | 9.2 | 3 9 12 | 59.0 | 9 51.3 | 0.68 |
| 13 | 6 15 | 6 05 | 5 43 | 23 34 29 | 9.2 | 2 45 34 | 59.1 | 9 34.7 | 0.69 |
| 14 | 6 13 | 6 06 | sets | 23 38 9 | 9.2 | 2 21 54 | 59.2 | 9 17.9 | 0.70 |
| 15 | 6 12 | 6 06 | 6 50 | 23 41 49 | 9.1 | 1 58 13 | 59.2 | 9 0.9 | 0.71 |
| 16 | 6 10 | 6 07 | 7 50 | 23 45 28 | 9.1 | 1 34 31 | 59.3 | 8 43.7 | 0.72 |
| 17 | 6 08 | 6 08 | 8 55 | 23 49 7 | 9.1 | 1 10 48 | 59.3 | 8 26.2 | 0.73 |
| 18 | 6 07 | 6 09 | 9 57 | 23 52 46 | 9.1 | 0 47 5 | 59.3 | 8 8.6 | 0.74 |
| 19 | 6 06 | 6 10 | 11 04 | 23 56 24 | 9.1 | S. 0 23 22 | 59.3 | 7 50.7 | 0.75 |
| 20 | 6 05 | 6 11 | morn | 0 0 3 | 9.1 | N. 0 0 20 | 59.2 | 7 32.7 | 0.75 |
| 21 | 6 03 | 6 12 | 0 11 | 0 3 41 | 9.1 | 0 24 2 | 59.2 | 7 14.6 | 0.76 |
| 22 | 6 02 | 6 13 | 1 15 | 0 7 20 | 9.1 | 0 47 41 | 59.1 | 6 56.3 | 0.76 |
| 23 | 6 01 | 6 14 | 2 13 | 0 10 58 | 9.1 | 1 11 20 | 59.1 | 6 38.0 | 0.77 |
| 24 | 5 59 | 6 15 | 3 03 | 0 14 36 | 9.1 | 1 34 56 | 59.0 | 6 19.5 | 0.77 |
| 25 | 5 57 | 6 16 | 3 46 | 0 18 14 | 9.1 | 1 58 30 | 58.9 | 6 1.0 | 0.77 |
| 26 | 5 56 | 6 17 | 4 20 | 0 21 52 | 9.1 | 2 22 1 | 58.7 | 5 42.5 | 0.77 |
| 27 | 5 54 | 6 18 | 4 50 | 0 25 30 | 9.1 | 2 45 29 | 58.6 | 5 23.9 | 0.77 |
| 28 | 5 53 | 6 19 | rises | 0 29 8 | 9.1 | 3 8 54 | 58.5 | 5 5.4 | 0.77 |
| 29 | 5 51 | 6 20 | 7 36 | 0 32 46 | 9.1 | 3 32 15 | 58.3 | 4 46.9 | 0.77 |
| 30 | 5 49 | 6 21 | 8 45 | 0 36 24 | 9.1 | 3 55 32 | 58.1 | 4 28.5 | 0.77 |
| 31 | 5 48 | 6 22 | 9 53 | 0 40 2 | 9.1 | 4 18 45 | 57.9 | 4 10.1 | 0.76 |

# APRIL, 1877.

| Day of Week. | Day of Month. | San Francisco. HIGH WATER. | | San Diego. HIGH WATER. | | Astoria. HIGH WATER. | | Port Townsend. HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Small. | Large. | Small. | Large. | Small. | Large. | Large. | Small. |
| | | P.M. | A.M. | P.M. | P.M. | P.M. | A.M. | A.M. | P.M. |
| Sun | 1 | 2 33 | 1 17 | 0 45 | 11 45 | 3 25 | 2 17 | 5 11 | 8 20 |
| Mon | 2 | 3 54 | 1 56 | 2 30 | A.M. | 4 12 | 2 51 | 5 33 | 9 36 |
| Tues | 3 | 5 00 | 2 47 | 4 25 | 0 35 | 5 10 | 3 37 | small | large |
| Wed | 4 | 6 08 | 3 53 | 5 45 | 1 40 | 6 11 | 4 29 | 6 33 | 11 38 |
| Thur | 5 | 7 14 | 4 44 | 6 36 | 2 52 | 7 13 | 5 26 | 7 17 | A.M. |
| Frid | 6 | 8 19 | 5 47 | 7 10 | 3 57 | 8 16 | 6 25 | 8 17 | 0 23 |
| Sat | 7 | 9 02 | 6 51 | 7 32 | 5 00 | 9 14 | 7 29 | 9 28 | 1 00 |
| Sun | 8 | 9 45 | 7 47 | 7 50 | 5 50 | 10 05 | 8 33 | 10 45 | 1 37 |
| Mon | 9 | 10 23 | 8 42 | 8 11 | 6 35 | 10 49 | 9 32 | P.M. | 2 11 |
| Tues | 10 | large | small | large | small | large | small | 1 15 | 2 43 |
| Wed | 11 | 11 12 | 10 23 | 8 47 | 7 55 | 11 52 | 11 20 | 2 36 | 3 10 |
| Thur | 12 | 11 31 | 11 13 | 9 01 | 8 38 | A.M. | P.M. | 3 40 | 3 26 |
| Frid | 13 | 11 53 | 11 58 | 9 14 | 9 15 | 0 18 | 0 50 | 4 43 | 3 41 |
| Sat | 14 | A.M. | P.M. | 9 36 | 10 00 | 0 47 | 1 43 | 5 47 | 3 53 |
| Sun | 15 | 0 17 | 1 40 | 10 00 | 11 03 | 1 15 | 2 18 | 6 56 | 4 08 |
| Mon | 16 | 0 46 | 2 40 | 10 37 | P.M. | 1 44 | 3 05 | 8 07 | 4 25 |
| Tues | 17 | 1 26 | 3 41 | 11 30 | 1 40 | 2 20 | 3 54 | 9 15 | 4 47 |
| Wed | 18 | 2 23 | 4 48 | A.M. | 3 03 | 3 07 | 4 55 | large | small |
| Thur | 19 | 3 32 | 5 55 | 0 35 | 4 15 | 4 07 | 5 59 | 11 16 | 6 16 |
| Frid | 20 | 4 41 | 7 02 | 2 10 | 5 30 | 5 16 | 7 06 | A.M. | 7 22 |
| Sat | 21 | 5 46 | 8 03 | 3 50 | 6 25 | 6 32 | 8 09 | 0 05 | 8 38 |
| Sun | 22 | 6 56 | 8 56 | 5 08 | 7 16 | 7 45 | 9 10 | 0 45 | 10 05 |
| Mon | 23 | small | large | small | large | small | large | 1 24 | 11 36 |
| Tues | 24 | 9 09 | 10 25 | 7 00 | 8 15 | 10 08 | 10 59 | 1 59 | P.M. |
| Wed | 25 | 10 14 | 10 55 | 7 55 | 8 35 | 11 11 | 11 40 | 2 31 | 2 37 |
| Thur | 26 | 11 11 | 11 19 | 8 40 | 9 00 | P.M. | A.M. | 2 58 | 3 59 |
| Frid | 27 | P.M. | 11 46 | 9 30 | 9 23 | 0 58 | 0 15 | 3 16 | 5 13 |
| Sat | 28 | 1 00 | A.M. | 10 21 | 9 45 | 1 38 | 0 42 | 3 33 | 6 21 |
| Sun | 29 | 1 57 | 0 16 | 11 15 | 10 10 | 2 21 | 1 12 | 3 50 | 7 26 |
| Mon | 30 | 2 56 | 0 57 | P.M. | 10 42 | 3 10 | 1 42 | 4 04 | 8 25 |

# APRIL, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *added* to *subtracted* from Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 5 45 | 6 23 | 11 00 | 0 43 40 | 9.1 | N. 4 41 53 | 57.7 | 3 51.9 | 0.76 |
| 2 | 5 44 | 6 24 | morn | 0 47 19 | 9.1 | 5 4 57 | 57.5 | 3 33.7 | 0.75 |
| 3 | 5 42 | 6 25 | 0 01 | 0 50 57 | 9.1 | 5 27 55 | 57.3 | 3 15.7 | 0.74 |
| 4 | 5 41 | 6 25 | 0 55 | 0 54 36 | 9.1 | 5 50 47 | 57.1 | 2 57.9 | 0.74 |
| 5 | 5 40 | 6 26 | 1 42 | 0 58 15 | 9.1 | 6 13 33 | 56.8 | 2 40.3 | 0.73 |
| 6 | 5 39 | 6 27 | 2 22 | 1 1 54 | 9.1 | 6 36 14 | 56.5 | 2 22.9 | 0.72 |
| 7 | 5 37 | 6 27 | 2 55 | 1 5 33 | 9.1 | 6 58 47 | 56.2 | 2 5.7 | 0.71 |
| 8 | 5 36 | 6 28 | 3 22 | 1 9 13 | 9.2 | 7 21 14 | 55.9 | 1 48.7 | 0.70 |
| 9 | 5 35 | 6 29 | 3 48 | 1 12 52 | 9.2 | 7 43 33 | 55.6 | 1 32.0 | 0.69 |
| 10 | 5 33 | 6 30 | 4 11 | 1 16 32 | 9.2 | 8 5 45 | 55.3 | 1 15.6 | 0.68 |
| 11 | 5 32 | 6 31 | 4 32 | 1 20 13 | 9.2 | 8 27 48 | 55.0 | 0 59.5 | 0.67 |
| 12 | 5 30 | 6 32 | 4 54 | 1 23 54 | 9.2 | 8 49 43 | 54.6 | 0 43.6 | 0.65 |
| 13 | 5 29 | 6 33 | sets | 1 27 35 | 9.2 | 9 11 29 | 54 2 | 0 28.1 | 0.64 |
| 14 | 5 27 | 6 34 | 7 47 | 1 31 16 | 9.2 | 9 33 6 | 53.8 | 0 12.9 | 0.63 |
| 15 | 5 25 | 6 35 | 8 55 | 1 34 57 | 9.2 | 9 54 34 | 53.4 | 0 1.9 | 0.61 |
| 16 | 5 24 | 6 36 | 10 02 | 1 38 39 | 9.3 | 10 15 51 | 53.0 | 0 16.4 | 0.60 |
| 17 | 5 22 | 6 37 | 11 08 | 1 42 22 | 9.3 | 10 36 59 | 52.6 | 0 30.6 | 0.58 |
| 18 | 5 21 | 6 37 | morn | 1 46 5 | 9.3 | 10 57 56 | 52.1 | 0 44.3 | 0.56 |
| 19 | 5 20 | 6 38 | 0 09 | 1 49 48 | 9.3 | 11 18 42 | 51.7 | 0 57.7 | 0.55 |
| 20 | 5 19 | 6 39 | 1 01 | 1 53 31 | 9.3 | 11 39 16 | 51.2 | 1 10.7 | 0.53 |
| 21 | 5 18 | 6 40 | 1 45 | 1 57 15 | 9 3 | 11 59 39 | 50.7 | 1 23.3 | 0.51 |
| 22 | 5 16 | 6 41 | 2 21 | 2 1 0 | 9.4 | 12 19 50 | 50.2 | 1 35.4 | 0.50 |
| 23 | 5 15 | 6 42 | 2 52 | 2 4 44 | 9.4 | 12 39 49 | 49.7 | 1 47.1 | 0.48 |
| 24 | 5 13 | 6 43 | 3 20 | 2 8 30 | 9.4 | 12 59 36 | 49.2 | 1 58.4 | 0.46 |
| 25 | 5 12 | 6 44 | 3 45 | 2 12 15 | 9.4 | 13 19 9 | 48.6 | 2 9.2 | 0.44 |
| 26 | 5 11 | 6 45 | 4 12 | 2 16 2 | 9.4 | 13 38 30 | 48.1 | 2 19.5 | 0.42 |
| 27 | 5 10 | 6 45 | rises | 2 19 48 | 9.5 | 13 57 37 | 47.5 | 2 29.3 | 0.40 |
| 28 | 5 08 | 6 46 | 8 41 | 2 23 36 | 9.5 | 14 16 30 | 46.9 | 2 38.6 | 0.38 |
| 29 | 5 07 | 6 47 | 9 45 | 2 27 23 | 9.5 | 14 35 9 | 46.3 | 2 47.4 | 0.36 |
| 30 | 5 06 | 6 48 | 10 43 | 2 31 12 | 9.5 | 14 53 34 | 45.7 | 2 55.7 | 0.33 |

# MAY, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Small. | Large. | Small. | Large. | Small. | Large. | Small. | Large. |
| | | P.M. | A.M. | P.M. | P.M. | P.M. | A.M. | A.M. | P.M. |
| Tues..... | 1 | 3 53 | 1 27 | 2 00 | 11 20 | 4 01 | 2 17 | 4 35 | 9 21 |
| Wed..... | 2 | 4 50 | 2 20 | 3 30 | A.M. | 4 54 | 3 06 | 4 58 | 10 09 |
| Thur..... | 3 | 5 47 | 3 21 | 4 45 | 0 05 | 5 48 | 3 58 | 5 56 | 10 52 |
| Frid..... | 4 | 6 40 | 4 17 | 5 35 | 1 00 | 6 20 | 4 54 | 6 57 | 11 25 |
| Sat..... | 5 | 7 23 | 5 18 | 6 15 | 2 12 | 7 32 | 5 57 | 8 08 | 11 59 |
| **Sun**..... | 6 | 8 01 | 6 08 | 6 48 | 3 50 | 8 23 | 6 59 | 9 26 | A.M. |
| Mon..... | 7 | large | small | large | small | large | small | 10 42 | 0 27 |
| Tues..... | 8 | 9 14 | 8 05 | 7 30 | 6 10 | 9 52 | 8 58 | 11 58 | 0 55 |
| Wed..... | 9 | 9 46 | 9 03 | 7 46 | 7 05 | 10 30 | 9 55 | P.M. | 1 23 |
| Thur..... | 10 | 10 14 | 10 00 | 8 05 | 7 50 | 10 51 | 11 04 | 2 38 | 1 50 |
| Frid..... | 11 | 10 41 | 10 55 | 8 25 | 8 42 | 11 38 | 11 40 | 4 09 | 2 14 |
| Sat..... | 12 | 11 14 | 11 53 | 8 50 | 9 30 | A.M. | P.M. | 5 37 | 2 35 |
| **Sun**..... | 13 | 11 53 | P.M. | 9 24 | 10 18 | 0 16 | 1 23 | 6 35 | 2 57 |
| Mon..... | 14 | A.M. | 1 48 | 9 51 | 11 15 | 0 52 | 2 15 | 7 19 | 3 18 |
| Tues..... | 15 | 0 34 | 2 47 | 10 30 | P.M. | 1 34 | 3 05 | large | small |
| Wed..... | 16 | 1 20 | 3 43 | 11 23 | 1 50 | 2 18 | 3 56 | 8 55 | 4 16 |
| Thur..... | 17 | 2 12 | 4 39 | A.M. | 3 10 | 3 05 | 4 49 | 9 41 | 4 54 |
| Frid..... | 18 | 3 17 | 5 35 | 0 45 | 4 15 | 4 01 | 5 44 | 10 27 | 5 59 |
| Sat..... | 19 | 4 23 | 6 29 | 2 10 | 5 15 | 5 03 | 6 39 | 11 08 | 7 30 |
| **Sun**..... | 20 | 5 33 | 7 19 | 3 35 | 6 00 | 6 13 | 7 33 | 11 48 | 9 05 |
| Mon..... | 21 | small | large | small | large | small | large | A.M. | 10 46 |
| Tues..... | 22 | 7 58 | 8 51 | 6 10 | 7 00 | 8 38 | 9 22 | 0 23 | P.M. |
| Wed..... | 23 | 9 18 | 9 33 | 7 00 | 7 25 | 9 50 | 10 13 | 0 53 | 1 42 |
| Thur..... | 24 | 10 14 | 10 01 | 7 47 | 7 51 | 11 00 | 10 57 | 1 22 | 3 03 |
| Frid..... | 25 | 11 12 | 10 41 | 8 35 | 8 24 | P.M. | 11 37 | 1 50 | 4 26 |
| Sat..... | 26 | P.M. | 11 14 | 9 30 | 8 58 | 0 55 | A.M. | 2 14 | 5 42 |
| **Sun**..... | 27 | 1 04 | 11 44 | 10 30 | 9 25 | 1 37 | 0 15 | 2 34 | 6 47 |
| Mon..... | 28 | 1 57 | A.M. | 11 30 | 9 56 | 2 16 | 0 44 | 2 58 | 7 36 |
| Tues..... | 29 | 2 45 | 0 25 | P.M. | 10 30 | 2 57 | 1 17 | 3 17 | 8 12 |
| Wed..... | 30 | 3 27 | 1 07 | 1 45 | 11 08 | 3 37 | 1 57 | 3 50 | 8 41 |
| Thur..... | 31 | 4 09 | 1 52 | 3 00 | 11 45 | 4 23 | 2 43 | 4 30 | 9 10 |

# MAY, 1877.

| Day of Month. | *San Francisco.* | | | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour | Equation of Time, to be *subtracted* from Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | Sun rises. | Sun sets. | Moon rises. | | | | | | |
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 5 05 | 6 49 | 11 34 | 2 35 0 | 9.5 | N.15 11 45 | 45.1 | 3 3.4 | 0.31 |
| 2 | 5 04 | 6 50 | morn | 2 38 50 | 9.6 | 15 29 40 | 44.5 | 3 10.6 | 0.29 |
| 3 | 5 02 | 6 51 | 0 17 | 2 42 40 | 9.6 | 15 47 20 | 43.8 | 3 17.2 | 0.26 |
| 4 | 5 01 | 6 52 | 0 54 | 2 46 30 | 9.6 | 16 4 45 | 43.2 | 3 23.3 | 0.24 |
| 5 | 5 00 | 6 53 | 1 24 | 2 50 21 | 9.6 | 16 21 54 | 42.5 | 3 28.7 | 0.22 |
| 6 | 4 59 | 6 54 | 1 50 | 2 54 13 | 9.7 | 16 38 47 | 41.8 | 3 33.6 | 0.19 |
| 7 | 4 58 | 6 54 | 2 12 | 2 58 5 | 9.7 | 16 55 23 | 41.2 | 3 37.9 | 0.17 |
| 8 | 4 57 | 6 55 | 2 34 | 3 1 58 | 9.7 | 17 11 42 | 40.4 | 3 41.6 | 0.14 |
| 9 | 4 56 | 6 56 | 2 56 | 3 5 51 | 9.7 | 17 27 45 | 39.7 | 3 44.7 | 0.12 |
| 10 | 4 55 | 6 57 | 3 19 | 3 9 45 | 9.8 | 17 43 29 | 39.0 | 3 47.3 | 0.09 |
| 11 | 4 54 | 6 58 | 3 45 | 3 13 40 | 9.8 | 17 58 57 | 38.2 | 3 49.2 | 0.07 |
| 12 | 4 53 | 6 59 | sets | 3 17 35 | 9.8 | 18 14 6 | 37.5 | 3 50.6 | 0.04 |
| 13 | 4 52 | 7 00 | 7 48 | 3 21 31 | 9.8 | 18 28 56 | 36.7 | 3 51.4 | 0.02 |
| 14 | 4 51 | 7 01 | 8 55 | 3 25 27 | 9.9 | 18 43 28 | 35.9 | 3 51.6 | 0.00 |
| 15 | 4 51 | 7 01 | 10 00 | 3 29 24 | 9.9 | 18 57 41 | 35.1 | 3 51.3 | 0.03 |
| 16 | 4 50 | 7 02 | 10 57 | 3 33 22 | 9.9 | 19 11 35 | 34.3 | 3 50.4 | 0.05 |
| 17 | 4 49 | 7 03 | 11 44 | 3 37 20 | 9.9 | 19 25 9 | 33·5 | 3 48.9 | 0.07 |
| 18 | 4 48 | 7 04 | morn | 3 41 18 | 10.0 | 19 38 23 | 32.7 | 3 46.9 | 0.09 |
| 19 | 4 47 | 7 05 | 0 23 | 3 45 17 | 10.0 | 19 51 18 | 31.8 | 3 44.4 | 0.12 |
| 20 | 4 47 | 7 05 | 0 55 | 3 49 17 | 10.0 | 20 3 51 | 31.0 | 3 41.3 | 0.14 |
| 21 | 4 46 | 7 06 | 1 23 | 3 53 17 | 10 0 | 20 16· 5 | 30.1 | 3 37.7 | 0.16 |
| 22 | 4 45 | 7 07 | 1 49 | 3 57 18 | 10.0 | 20 27 57 | 29.2 | 3 33.6 | 0.18 |
| 23 | 4 45 | 7 08 | 2 16 | 4 1 19 | 10.1 | 20 39 29 | 28.4 | 3 29.0 | 0.20 |
| 24 | 4 44 | 7 09 | 2 42 | 4 5 21 | 10.1 | 20 50 39 | 27.5 | 3 23.9 | 0.22 |
| 25 | 4 44 | 7 10 | 3 11 | 4 9 23 | 10.1 | 21 1 28 | 26.6 | 3 18.3 | 0.24 |
| 26 | 4 43 | 7 10 | rises | 4 13 25 | 10.1 | 21 11 55 | 25.7 | 3 12.2 | 0.26 |
| 27 | 4 43 | 7 11 | 8 31 | 4 17 29 | 10.1 | 21 22 0 | 24.7 | 3 5.7 | 0.28 |
| 28 | 4 42 | 7 12 | 9 25 | 4 21 32 | 10.2 | 21 31 44 | 23.8 | 2 58.6 | 0.30 |
| 29 | 4 41 | 7 12 | 10 11 | 4 25 36 | 10.2 | 21 41 5 | 22.9 | 2 51.1 | 0 32 |
| 30 | 4 41 | 7 13 | 10 50 | 4 29 41 | 10.2 | 21 50 3 | 22.0 | 2 43.2 | 0.34 |
| 31 | 4 40 | 7 13 | 11 22 | 4 33 46 | 10.2 | 21 58 39 | 21.0 | 2 34.8 | 0.36 |

# JUNE, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Small. | Large. | Small. | Large. | Small. | Large. | Small. | Large. |
| | | P.M. | A.M. | P.M. | | P.M. | A.M. | A.M. | P.M. |
| Frid..... | 1 | 4 49 | 2 42 | 4 00 | A.M. | 5 10 | 3 30 | 5 30 | 9 45 |
| Sat..... | 2 | 5 30 | 3 33 | 4 35 | 0 25 | 5 53 | 4 17 | 6 46 | 10 04 |
| **Sun**..... | 3 | 6 10 | 4 28 | 5 10 | 1 15 | 6 34 | 5 10 | 8 03 | 10 34 |
| Mon..... | 4 | large | small | large | small | large | small | 9 22 | 11 02 |
| Tues..... | 5 | 7 24 | 6 28 | 6 10 | 4 30 | 7 57 | 7 10 | 10 34 | 11 40 |
| Wed..... | 6 | 8 01 | 7 35 | 6 42 | 5 46 | 8 35 | 8 14 | 11 55 | 11 58 |
| Thur..... | 7 | 8 53 | 8 44 | 7 03 | 6 37 | 9 23 | 9 19 | P.M. | A.M. |
| Frid..... | 8 | 9 25 | 9 52 | 7 25 | 7 35 | 10 11 | 10 23 | 2 55 | 0 26 |
| Sat..... | 9 | 10 06 | 10 58 | 7 45 | 8 34 | 11 01 | 11 26 | 4 15 | 0 57 |
| **Sun**..... | 10 | 10 44 | 11 59 | 8 10 | 9 32 | 11 49 | P.M. | 5 33 | 1 28 |
| Mon..... | 11 | 11 29 | P.M. | 8 38 | 10 30 | A.M. | 1 21 | large | small |
| Tues..... | 12 | A.M. | 1 54 | 9 30 | 11 30 | 0 34 | 2 15 | 7 25 | 2 28 |
| Wed..... | 13 | 0 17 | 2 47 | 10 45 | P.M. | 1 15 | 3 03 | 8 00 | 3 11 |
| Thur..... | 14 | 1 09 | 3 33 | 11 30 | 1 30 | 2 03 | 3 49 | 8 35 | 3 57 |
| Frid..... | 15 | 2 03 | 4 09 | A.M. | 2 27 | 2 56 | 4 27 | 8 52 | 4 58 |
| Sat..... | 16 | 3 07 | 4 54 | 0 05 | 3 15 | 3 55 | 5 15 | 9 20 | 6 27 |
| **Sun**..... | 17 | 4 14 | 5 40 | 0 50 | 4 10 | 4 58 | 5 59 | 9 51 | 8 00 |
| Mon..... | 18 | small | large | small | large | small | large | 10 25 | 9 29 |
| Tues..... | 19 | 6 37 | 7 11 | 4 00 | 5 42 | 7 12 | 7 41 | 11 02 | 10 55 |
| Wed..... | 20 | 7 53 | 7 56 | 5 40 | 6 15 | 8 25 | 8 34 | 11 38 | P.M. |
| Thur..... | 21 | 9 10 | 8 42 | 7 10 | 6 47 | 9 30 | 9 26 | A.M. | 1 58 |
| Frid..... | 22 | 10 31 | 9 27 | 8 30 | 7 15 | 10 43 | 10 21 | 0 16 | 3 30 |
| Sat..... | 23 | 11 21 | 10 07 | 9 15 | 7 48 | 11 45 | 11 09 | 0 53 | 4 52 |
| **Sun**..... | 24 | P.M. | 10 46 | 10 05 | 8 23 | P.M. | 11 53 | small | large |
| Mon..... | 25 | 1 05 | 11 23 | 10 55 | 8 50 | 1 29 | A.M. | 1 52 | 6 31 |
| Tues..... | 26 | 1 48 | A.M. | 11 38 | 9 30 | 2 10 | 0 33 | 2 17 | 7 04 |
| Wed..... | 27 | 2 26 | 0 08 | P.M. | 10 00 | 2 46 | 1 11 | 2 40 | 7 32 |
| Thur..... | 28 | 2 58 | 0 50 | 1 02 | 10 38 | 3 14 | 1 48 | 3 20 | 7 52 |
| Frid..... | 29 | 3 26 | 1 30 | 1 45 | 11 20 | 3 41 | 2 24 | 4 19 | 8 10 |
| Sat..... | 30 | 3 50 | 2 13 | 2 20 | 11 59 | 4 14 | 3 04 | 5 30 | 8 25 |

# JUNE, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *subtracted* from / *added* to Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 4 40 | 7 14 | 11 49 | 4 37 51 | 10.2 | N. 22 6 52 | 20.0 | 2 26.0 | 0.38 |
| 2 | 4 40 | 7 15 | morn | 4 41 57 | 10.2 | 22 14 42 | 19.1 | 2 16.8 | 0.39 |
| 3 | 4 40 | 7 16 | 0 14 | 4 46 3 | 10.3 | 22 22 8 | 18.1 | 2 7.1 | 0.41 |
| 4 | 4 40 | 7 17 | 0 36 | 4 50 10 | 10.3 | 22 29 12 | 17.1 | 1 57.1 | 0.42 |
| 5 | 4 40 | 7 17 | 0 58 | 4 54 17 | 10.3 | 22 35 51 | 16.1 | 1 46.7 | 0.44 |
| 6 | 4 39 | 7 18 | 1 20 | 4 58 24 | 10.3 | 22 42 8 | 15.1 | 1 36.0 | 0.45 |
| 7 | 4 39 | 7 18 | 1 44 | 5 2 32 | 10.3 | 22 48 0 | 14.2 | 1 25.0 | 0.47 |
| 8 | 4 39 | 7 19 | 2 13 | 5 6 40 | 10.3 | 22 53 28 | 13.2 | 1 13.6 | 0.48 |
| 9 | 4 39 | 7 19 | 2 48 | 5 10 48 | 10.3 | 22 58 32 | 12.2 | 1 2.0 | 0.49 |
| 10 | 4 39 | 7 20 | sets | 5 14 56 | 10.4 | 23 3 12 | 11.1 | 0 50.1 | 0.50 |
| 11 | 4 39 | 7 20 | 7 44 | 5 19 5 | 10.4 | 23 7 27 | 10.1 | 0 38.0 | 0.51 |
| 12 | 4 39 | 7 21 | 8 46 | 5 23 14 | 10.4 | 23 11 18 | 9.1 | 0 25.7 | 0.52 |
| 13 | 4 39 | 7 21 | 9 37 | 5 27 23 | 10.4 | 23 14 44 | 8.1 | 0 13.2 | 0.52 |
| 14 | 4 39 | 7 21 | 10 20 | 5 31 32 | 10.4 | 23 17 46 | 7.1 | 0 0.6 | 0.53 |
| 15 | 4 39 | 7 22 | 10 56 | 5 35 42 | 10.4 | 23 20 23 | 6.0 | 0 12.1 | 0.53 |
| 16 | 4 39 | 7 22 | 11 26 | 5 39 51 | 10.4 | 23 22 36 | 5.0 | 0 25.0 | 0.54 |
| 17 | 4 39 | 7 22 | 11 54 | 5 44 0 | 10.4 | 23 24 23 | 4.0 | 0 37.9 | 0.54 |
| 18 | 4 40 | 7 23 | morn | 5 48 10 | 10.4 | 23 25 46 | 2.9 | 0 50.4 | 0.54 |
| 19 | 4 40 | 7 23 | 0 19 | 5 52 20 | 10.4 | 23 26 44 | 1.9 | 1 3.8 | 0.54 |
| 20 | 4 40 | 7 23 | 0 45 | 5 56 29 | 10.4 | 23 27 17 | 0.9 | 1 16.8 | 0.54 |
| 21 | 4 40 | 7 23 | 1 13 | 6 0 39 | 10.4 | 23 27 26 | 0.2 | 1 29.7 | 0.54 |
| 22 | 4 40 | 7 23 | 1 45 | 6 4 48 | 10.4 | 23 27 10 | 1.2 | 1 42.6 | 0.54 |
| 23 | 4 41 | 7 24 | 2 25 | 6 8 58 | 10.4 | 23 26 28 | 2.2 | 1 55.5 | 0.53 |
| 24 | 4 41 | 7 24 | 3 12 | 6 13 7 | 10.4 | 23 25 23 | 3.2 | 2 8.2 | 0.53 |
| 25 | 4 41 | 7 24 | rises | 6 17 16 | 10.4 | 23 23 52 | 4.3 | 2 20.8 | 0.52 |
| 26 | 4 41 | 7 24 | 8 48 | 6 21 25 | 10.4 | 23 21 57 | 5.3 | 2 33.4 | 0.52 |
| 27 | 4 42 | 7 24 | 9 22 | 6 25 34 | 01.4 | 23 19 37 | 6.3 | 2 45.7 | 0.51 |
| 28 | 4 42 | 7 24 | 9 51 | 6 29 43 | 10.4 | 23 16 53 | 7.3 | 2 57.9 | 0.50 |
| 29 | 4 42 | 7 24 | 10 17 | 6 33 52 | 10.4 | 23 13 44 | 8.4 | 3 10.0 | 0.50 |
| 30 | 4 43 | 7 24 | 10 39 | 6 38 0 | 10.3 | 23 10 11 | 9.4 | 3 21.8 | 0.49 |

# JULY, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Large. | Small. | Large. | Small. | Large. | Small. | Small. | Large. |
| | | P.M. | A.M. | P.M. | | P.M. | A.M. | A.M. | P.M. |
| Sun..... | 1 | 4 18 | 3 02 | 2 47 | A.M. | 4 46 | 3 48 | 6 46 | 8 45 |
| Mon..... | 2 | 4 55 | 3 56 | 3 10 | 0 50 | 5 23 | 4 38 | 8 03 | 9 06 |
| Tues..... | 3 | 5 32 | 4 58 | 3 35 | 1 45 | 6 02 | 5 33 | 9 16 | 9 28 |
| Wed..... | 4 | 6 11 | 6 03 | 4 15 | 2 50 | 6 46 | 6 32 | 10 34 | 9 57 |
| Thur..... | 5 | 6 58 | 7 10 | 5 05 | 4 35 | 7 36 | 7 36 | 11 57 | 10 32 |
| Frid..... | 6 | 7 52 | 8 25 | 5 05 | 6 30 | 8 31 | 8 45 | P.M. | 11 12 |
| Sat..... | 7 | 8 49 | 9 43 | 6 50 | 8 00 | 9 35 | 9 57 | 3 00 | 11 56 |
| Sun..... | 8 | 9 45 | 10 53 | 7 36 | 9 05 | 10 38 | 11 14 | 4 28 | A.M. |
| Mon..... | 9 | 10 37 | 11 55 | 8 15 | 9 56 | 11 36 | P.M. | large | small |
| Tues..... | 10 | 11 26 | P.M. | 9 00 | 10 30 | A.M. | 1 12 | 6 23 | 1 34 |
| Wed..... | 11 | A.M. | 1 45 | 9 40 | 11 15 | 0 30 | 1 59 | 6 49 | 2 22 |
| Thur..... | 12 | 0 13 | 2 02 | 10 22 | 11 57 | 1 15 | 2 44 | 7 08 | 3 10 |
| Frid..... | 13 | 1 00 | 2 53 | 11 15 | P.M. | 2 00 | 3 19 | 7 23 | 4 10 |
| Sat..... | 14 | 1 51 | 3 21 | A.M. | 1 10 | 2 46 | 3 49 | 7 40 | 5 28 |
| Sun..... | 15 | small | large | small | large | small | large | 8 08 | 6 50 |
| Mon..... | 16 | 4 04 | 4 48 | 1 00 | 2 30 | 4 44 | 5 13 | 8 43 | 8 17 |
| Tues..... | 17 | 5 20 | 5 40 | 2 00 | 3 10 | 5 52 | 6 09 | 9 22 | 9 52 |
| Wed..... | 18 | 6 38 | 6 28 | 3 35 | 4 05 | 7 02 | 7 04 | 9 58 | 11 30 |
| Thur..... | 19 | 8 00 | 7 17 | 5 48 | 5 00 | 8 15 | 8 01 | 10 32 | P.M. |
| Frid..... | 20 | 9 19 | 8 06 | 7 40 | 6 05 | 9 27 | 8 57 | 11 13 | 2 37 |
| Sat..... | 21 | 10 24 | 8 56 | 8 50 | 7 05 | 10 34 | 9 49 | small | large |
| Sun..... | 22 | 11 15 | 9 42 | 9 40 | 7 50 | 11 32 | 10 40 | A.M. | 4 47 |
| Mon..... | 23 | 11 58 | 10 28 | 10 16 | 8 30 | P.M. | 11 28 | 0 34 | 5 21 |
| Tues..... | 24 | P.M. | 11 08 | 10 45 | 9 00 | 1 10 | A.M. | 1 14 | 5 45 |
| Wed..... | 25 | 1 13 | 11 47 | 11 10 | 9 30 | 1 48 | 0 11 | 1 56 | 6 11 |
| Thur..... | 26 | 1 42 | A.M. | 11 25 | 9 57 | 2 18 | 0 49 | 2 46 | 6 32 |
| Frid..... | 27 | 2 07 | 0 25 | 11 45 | 10 25 | 2 45 | 1 25 | 3 43 | 6 49 |
| Sat..... | 28 | 2 27 | 1 07 | P.M. | 11 00 | 3 04 | 2 00 | 4 43 | 7 04 |
| Sun..... | 29 | large | small | large | small | large | small | 5 43 | 7 13 |
| Mon..... | 30 | 3 14 | 2 32 | 1 00 | A.M. | 3 45 | 3 18 | 6 50 | 7 24 |
| Tues..... | 31 | 3 46 | 3 28 | 1 45 | 0 35 | 4 14 | 4 10 | 8 00 | 7 45 |

# JULY, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *added* to Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 4 44 | 7 24 | 11 00 | 6 42 8 | 10.3 | N.23 6 14 | 10.4 | 3 33.4 | 0.48 |
| 2 | 4 44 | 7 24 | 11 22 | 6 46 16 | 10.3 | 23 1 52 | 11.4 | 3 44.7 | 0.47 |
| 3 | 4 44 | 7 23 | 11 45 | 6 50 24 | 10.3 | 22 57 6 | 12.4 | 3 55.8 | 0.46 |
| 4 | 4 45 | 7 23 | morn | 6 54 31 | 10.3 | 22 51 56 | 13.4 | 4 6.6 | 0.44 |
| 5 | 4 45 | 7 23 | 0 11 | 6 58 38 | 10.3 | 22 46 22 | 14.4 | 4 17.1 | 0.43 |
| 6 | 4 46 | 7 23 | 0 41 | 7 2 45 | 10.3 | 22 40 25 | 15.4 | 4 27.3 | 0.42 |
| 7 | 4 46 | 7 23 | 1 21 | 7 6 52 | 10.3 | 22 34 3 | 16.4 | 4 37.2 | 0.40 |
| 8 | 4 47 | 7 23 | 2 12 | 7 10 58 | 10.2 | 22 27 19 | 17.4 | 4 46.7 | 0.39 |
| 9 | 4 47 | 7 22 | 3 15 | 7 15 3 | 10.2 | 22 20 10 | 18.3 | 4 55.8 | 0.37 |
| 10 | 4 48 | 7 22 | sets | 7 19 9 | 10.2 | 22 12 39 | 19.3 | 5 4.4 | 0.35 |
| 11 | 4 48 | 7 22 | 8 14 | 7 23 13 | 10.2 | 22 4 45 | 20.2 | 5 12.7 | 0.33 |
| 12 | 4 49 | 7 21 | 8 53 | 7 27 18 | 10.2 | 21 56 28 | 21.2 | 5 20.5 | 0.32 |
| 13 | 4 49 | 7 21 | 9 26 | 7 31 22 | 10.2 | 21 47 48 | 22.1 | 5 27.8 | 0.30 |
| 14 | 4 50 | 7 21 | 9 54 | 7 35 25 | 10.1 | 21 38 46 | 23.0 | 5 34.7 | 0.27 |
| 15 | 4 51 | 7 20 | 10 21 | 7 39 28 | 10.1 | 21 29 22 | 24.0 | 5 41.0 | 0.25 |
| 16 | 4 51 | 7 20 | 10 48 | 7 43 30 | 10.1 | 21 19 36 | 24.9 | 5 46.8 | 0.23 |
| 17 | 4 52 | 7 19 | 11 17 | 7 47 32 | 10.1 | 21 9 28 | 25.8 | 5 52.1 | 0.21 |
| 18 | 4 53 | 7 19 | 11 47 | 7 51 34 | 10.0 | 20 58 59 | 26.7 | 5 56.9 | 0.19 |
| 19 | 4 53 | 7 18 | morn | 7 55 34 | 10.0 | 20 48 8 | 27.5 | 6 1.0 | 0.16 |
| 20 | 4 54 | 7 18 | 0 25 | 7 59 35 | 10.0 | 20 36 57 | 28.4 | 6 4.7 | 0.14 |
| 21 | 4 55 | 7 17 | 1 07 | 8 3 34 | 10.0 | 20 25 25 | 29.3 | 6 7.7 | 0.11 |
| 22 | 4 56 | 7 17 | 1 59 | 8 7 33 | 9.9 | 20 13 32 | 30.1 | 6 10.2 | 0.09 |
| 23 | 4 57 | 7 16 | 2 55 | 8 11 32 | 9.9 | 20 1 20 | 30.9 | 6 12.0 | 0.07 |
| 24 | 4 57 | 7 15 | rises | 8 15 30 | 9.9 | 19 48 47 | 31.8 | 6 13.3 | 0.04 |
| 25 | 4 58 | 7 14 | 7 55 | 8 19 27 | 9.9 | 19 35 54 | 32.6 | 6 14.0 | 0.02 |
| 26 | 4 59 | 7 13 | 8 21 | 8 23 23 | 9.8 | 19 22 42 | 33.4 | 6 14.1 | 0.01 |
| 27 | 5 00 | 7 12 | 8 43 | 8 27 19 | 9.8 | 19 9 11 | 34.2 | 6 13.7 | 0.03 |
| 28 | 5 01 | 7 11 | 9 05 | 8 31 15 | 9.8 | 18 55 20 | 35.0 | 6 12.6 | 0.05 |
| 29 | 5 02 | 7 11 | 9 26 | 8 35 10 | 9.8 | 18 41 11 | 35.8 | 6 10.9 | 0.08 |
| 30 | 5 03 | 7 10 | 9 48 | 8 39 4 | 9.8 | 18 26 44 | 36.5 | 6 8.7 | 0.10 |
| 31 | 5 04 | 7 09 | 10 12 | 8 42 58 | 9.7 | 18 11 58 | 37.3 | 6 5.9 | 0.13 |

# AUGUST, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Large. | Small. | Large. | Small. | Large. | Small. | Small. | Large. |
| | | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. | A.M. | P.M. |
| Wed. | 1 | 4 27 | 4 31 | 2 15 | 1 35 | 4 57 | 5 03 | 9 18 | 8 11 |
| Thur. | 2 | 5 17 | 5 44 | 3 00 | 3 05 | 5 51 | 6 04 | 10 44 | 8 47 |
| Frid. | 3 | 6 13 | 7 03 | 4 10 | 5 15 | 6 52 | 7 16 | P.M. | 9 28 |
| Sat. | 4 | 7 14 | 8 23 | 5 15 | 7 00 | 7 58 | 8 26 | 1 41 | 10 14 |
| **Sun** | 5 | 8 17 | 9 39 | 6 15 | 8 15 | 9 08 | 9 44 | large | small |
| Mon. | 6 | 9 23 | 10 51 | 7 20 | 9 00 | 10 17 | 11 01 | 4 17 | 11 58 |
| Tues. | 7 | 10 23 | 11 50 | 8 15 | 9 35 | 11 21 | P.M. | 4 55 | A.M. |
| Wed. | 8 | 11 16 | P.M. | 9 00 | 10 05 | A.M. | 1 03 | 5 33 | 1 04 |
| Thur. | 9 | A.M. | 1 06 | 9 40 | 10 35 | 0 15 | 1 45 | 5 58 | 2 20 |
| Frid. | 10 | 0 01 | 1 37 | 10 30 | 11 15 | 1 07 | 2 17 | 6 22 | 3 37 |
| Sat. | 11 | 0 46 | 2 03 | 11 15 | 11 45 | 1 54 | 2 47 | 6 35 | 4 54 |
| **Sun** | 12 | small | large | small | large | small | large | 6 47 | 6 05 |
| Mon. | 13 | 2 42 | 3 09 | A.M. | P.M. | 3 30 | 3 45 | 7 00 | 7 17 |
| Tues. | 14 | 3 54 | 3 57 | 0 48 | 1 40 | 4 26 | 4 25 | 7 31 | 8 36 |
| Wed. | 15 | 5 09 | 4 46 | 2 00 | 2 25 | 5 27 | 5 16 | 8 08 | 10 09 |
| Thur. | 16 | 6 31 | 5 40 | 4 18 | 3 15 | 6 34 | 6 10 | 8 52 | 11 47 |
| Frid. | 17 | 7 42 | 6 34 | 6 22 | 4 50 | 7 50 | 7 14 | 9 38 | P.M. |
| Sat. | 18 | 9 07 | 7 32 | 7 40 | 6 15 | 9 04 | 8 23 | small | large |
| **Sun** | 19 | 10 08 | 8 30 | 8 45 | 7 15 | 10 12 | 9 27 | 11 23 | 3 25 |
| Mon. | 20 | 10 59 | 9 23 | 9 30 | 7 50 | 11 13 | 10 22 | A.M. | 4 09 |
| Tues. | 21 | 11 37 | 10 11 | 10 00 | 8 23 | P.M. | 11 13 | 0 03 | 4 39 |
| Wed. | 22 | P.M. | 10 53 | 10 15 | 8 50 | 0 44 | 11 56 | 0 57 | 5 00 |
| Thur. | 23 | 0 30 | 11 28 | 10 30 | 9 22 | 1 16 | A..M | 1 59 | 5 18 |
| Frid. | 24 | 0 52 | A.M. | 10 45 | 9 45 | 1 38 | 0 35 | 3 02 | 5 35 |
| Sat. | 25 | 1 10 | 0 07 | 11 00 | 10 10 | 1 54 | 1 12 | 4 06 | 5 44 |
| **Sun** | 26 | large | small | large | small | large | small | 5 07 | 5 49 |
| Mon. | 27 | 1 45 | 1 31 | 11 37 | 11 20 | 2 25 | 2 20 | 6 08 | 5 57 |
| Tues | 28 | 2 13 | 2 18 | P.M. | A.M. | 2 55 | 3 07 | 7 08 | 6 05 |
| Wed. | 29 | 2 55 | 3 13 | 0 30 | 0 15 | 3 36 | 3 48 | 8 11 | 6 26 |
| Thur. | 30 | 3 42 | 4 20 | 1 05 | 1 23 | 4 24 | 4 43 | 9 27 | 7 02 |
| Frid. | 31 | 4 38 | 5 35 | 2 10 | 2 50 | 5 18 | 5 44 | 10 52 | 7 43 |

# AUGUST, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *added* to Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 5 04 | 7 08 | 10 40 | 8 46 51 | 9.7 | N.17 56 55 | 38.0 | 6 2.4 | 0.15 |
| 2 | 5 05 | 7 07 | 11 14 | 8 50 44 | 9.7 | 17 41 33 | 38.7 | 5 58.4 | 0.18 |
| 3 | 5 06 | 7 06 | 11 59 | 8 54 36 | 9.7 | 17 25 55 | 39.5 | 5 53.8 | 0.20 |
| 4 | 5 07 | 7 05 | morn | 8 58 27 | 9.6 | 17 9 59 | 40.2 | 5 48.7 | 0.23 |
| 5 | 5 08 | 7 04 | 0 54 | 9 2 18 | 9.6 | 16 53 46 | 40.9 | 5 42.9 | 0.25 |
| 6 | 5 09 | 7 03 | 2 01 | 9 6 8 | 9.6 | 16 37 17 | 41.5 | 5 36.6 | 0.28 |
| 7 | 5 10 | 7 02 | 3 17 | 9 9 58 | 9.6 | 16 20 32 | 42.2 | 5 29.6 | 0.30 |
| 8 | 5 11 | 7 00 | sets | 9 13 47 | 9.5 | 16 3 30 | 42.9 | 5 22.2 | 0.32 |
| 9 | 5 12 | 6 59 | 7 21 | 9 17 35 | 9.5 | 15 46 14 | 43.5 | 5 14.1 | 0.35 |
| 10 | 5 13 | 6 58 | 7 52 | 9 21 23 | 9.5 | 15 28 42 | 44.1 | 5 5.4 | 0.37 |
| 11 | 5 14 | 6 57 | 8 21 | 9 25 10 | 9.5 | 15 10 55 | 44.7 | 4 56.2 | 0.40 |
| 12 | 5 14 | 6 56 | 8 48 | 9 28 57 | 9.4 | 14 52 54 | 45.3 | 4 46.4 | 0.42 |
| 13 | 5 15 | 6 55 | 9 16 | 9 32 43 | 9.4 | 14 34 38 | 45.9 | 4 36.0 | 0.44 |
| 14 | 5 16 | 6 54 | 9 47 | 9 36 29 | 9.4 | 14 16 9 | 46.6 | 4 25.1 | 0.47 |
| 15 | 5 16 | 6 52 | 10 24 | 9 40 14 | 9.4 | 13 57 26 | 47.1 | 4 13.6 | 0.49 |
| 16 | 5 17 | 6 51 | 11 05 | 9 43 58 | 9.3 | 13 38 30 | 47.6 | 4 1.6 | 0.51 |
| 17 | 5 18 | 6 50 | 11 55 | 9 47 42 | 9.3 | 13 19 21 | 48.1 | 3 49.0 | 0.53 |
| 18 | 5 19 | 6 49 | morn | 9 51 26 | 9.3 | 12 59 59 | 48.7 | 3 35.9 | 0.55 |
| 19 | 5 20 | 6 48 | 0 49 | 9 55 9 | 9.3 | 12 40 25 | 49.2 | 3 22.3 | 0.58 |
| 20 | 5 21 | 6 46 | 1 49 | 9 58 51 | 9.3 | 12 20 40 | 49.6 | 3 8.3 | 0.60 |
| 21 | 5 22 | 6 44 | 2 51 | 10 2 33 | 9.2 | 12 0 42 | 50.1 | 2 53.7 | 0.62 |
| 22 | 5 22 | 6 43 | 3 51 | 10 6 14 | 9.2 | 11 40 33 | 50.6 | 2 38.7 | 0.63 |
| 23 | 5 23 | 6 41 | rises | 10 9 55 | 9.2 | 11 20 13 | 51.0 | 2 23.2 | 0.65 |
| 24 | 5 24 | 6 40 | 7 11 | 10 13 36 | 9.2 | 10 59 43 | 51.5 | 2 7.3 | 0.67 |
| 25 | 5 25 | 6 39 | 7 33 | 10 17 16 | 9.2 | 10 38 2 | 51.9 | 1 50.9 | 0.69 |
| 26 | 5 26 | 6 38 | 7 54 | 10 20 56 | 9.1 | 10 18 11 | 52.3 | 1 34.2 | 0.70 |
| 27 | 5 26 | 6 36 | 8 16 | 10 24 35 | 9.1 | 9 57 10 | 52.7 | 1 17.1 | 0.72 |
| 28 | 5 27 | 6 35 | 8 43 | 10 28 14 | 9.1 | 9 35 59 | 53.1 | 0 59.7 | 0.73 |
| 29 | 5 28 | 6 33 | 9 14 | 10 31 53 | 9.1 | 9 14 39 | 53.5 | 0 41.9 | 0.75 |
| 30 | 5 29 | 6 31 | 9 53 | 10 35 32 | 9.1 | 8 53 10 | 53.9 | 0 23.7 | 0.76 |
| 31 | 5 30 | 6 30 | 10 42 | 10 39 10 | 9.1 | 8 31 32 | 54.2 | 0 5.3 | 0.77 |

# SEPTEMBER, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Large. | Small. | Large. | Small. | Large. | Small. | Large. | Small. |
| | | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. | P.M. | P.M. |
| Sat..... | 1 | 5 50 | 6 56 | 3 30 | 5 00 | 6 22 | 6 58 | 0 20 | 8 31 |
| Sun..... | 2 | 6 49 | 8 17 | 5 00 | 6 50 | 7 33 | 8 17 | 1 42 | 9 30 |
| Mon..... | 3 | 8 00 | 9 30 | 6 25 | 8 00 | 8 50 | 9 37 | 2 46 | 10 38 |
| Tues..... | 4 | 9 09 | 10 34 | 7 30 | 8 30 | 10 05 | 10 48 | 3 31 | 11 55 |
| Wed..... | 5 | 10 09 | 11 22 | 8 15 | 8 50 | 11 11 | 11 44 | 4 03 | A.M. |
| Thur..... | 6 | 11 02 | 11 53 | 8 50 | 9 15 | A.M. | P.M. | 4 26 | 1 18 |
| Frid..... | 7 | 11 50 | P.M. | 9 30 | 9 40 | 0 05 | 1 04 | 4 50 | 2 38 |
| Sat..... | 8 | small | large | small | large | small | large | 5 12 | 3 55 |
| Sun..... | 9 | A.M. | 1 15 | 10 50 | 10 26 | 1 42 | 2 07 | 5 23 | 5 12 |
| Mon..... | 10 | 1 34 | 1 42 | 11 30 | 10 55 | 2 28 | 2 34 | 5 36 | 6 26 |
| Tues..... | 11 | 2 38 | 2 18 | A.M. | 11 30 | 3 15 | 3 05 | 5 55 | 7 40 |
| Wed..... | 12 | 3 47 | 3 07 | 0 45 | P.M. | 4 09 | 3 49 | 6 28 | 9 00 |
| Thur .... | 13 | 5 01 | 4 05 | 2 30 | 1 05 | 5 20 | 4 42 | 7 07 | 10 21 |
| Frid..... | 14 | 6 18 | 5 05 | 4 55 | 2 50 | 6 21 | 5 41 | small | large |
| Sat..... | 15 | 7 34 | 6 07 | 6 45 | 4 45 | 7 35 | 6 48 | 8 44 | P.M. |
| Sun..... | 16 | 8 39 | 7 08 | 7 40 | 6 10 | 8 48 | 7 53 | 9 49 | 1 59 |
| Mon..... | 17 | 9 36 | 8 06 | 8 17 | 7 00 | 9 50 | 8 58 | 10 58 | 2 44 |
| Tues..... | 18 | 10 21 | 8 59 | 8 45 | 7 30 | 10 42 | 9 55 | A.M. | 3 15 |
| Wed..... | 19 | 10 58 | 9 44 | 9 00 | 8 00 | 11 24 | 10 41 | 0 07 | 3 40 |
| Thur..... | 20 | 11 21 | 10 29 | 9 15 | 8 25 | 11 55 | 11 2 | 1 16 | 4 01 |
| Frid..... | 21 | 11 40 | 11 11 | 9 27 | 8 50 | P.M. | A.M. | 2 19 | 4 08 |
| Sat..... | 22 | large | small | large | small | large | small | 3 20 | 4 18 |
| Sun..... | 23 | P.M. | A.M. | 9 50 | 9 40 | 1 22 | 0 48 | 4 21 | 4 31 |
| Mon..... | 24 | 0 37 | 0 35 | 10 05 | 10 15 | 1 36 | 1 25 | 5 17 | 4 42 |
| Tues..... | 25 | 1 03 | 1 23 | 10 17 | 11 10 | 2 00 | 2 05 | 6 20 | 4 57 |
| Wed..... | 26 | 1 35 | 2 15 | 10 38 | A.M. | 2 25 | 2 45 | 7 27 | 5 15 |
| Thur .... | 27 | 2 17 | 3 14 | 11 05 | 0 15 | 2 59 | 3 31 | 8 34 | 5 35 |
| Frid..... | 28 | 3 12 | 4 19 | P.M. | 1 35 | 3 48 | 4 39 | 9 41 | 6 08 |
| Sat..... | 29 | 4 16 | 5 36 | 1 10 | 4 00 | 4 51 | 5 35 | large | small |
| Sun..... | 30 | 5 24 | 6 50 | 3 00 | 5 45 | 6 04 | 6 47 | 11 57 | 7 47 |

# SEPTEMBER, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *subtracted* from Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 5 31 | 6 28 | 11 46 | 10 42 47 | 9.1 | N. 8 9 46 | 54.6 | 0 13.4 | 0.79 |
| 2 | 5 32 | 6 27 | morn | 10 46 25 | 9.1 | 7 47 52 | 54.9 | 0 32.4 | 0.80 |
| 3 | 5 33 | 6 26 | 0 52 | 10 50 2 | 9.0 | 7 25 51 | 55.2 | 0 51.7 | 0.81 |
| 4 | 5 34 | 6 24 | 2 08 | 10 53 39 | 9.0 | 7 3 42 | 55.5 | 1 11.2 | 0.82 |
| 5 | 5 34 | 6 23 | 3 28 | 10 57 16 | 9.0 | 6 41 25 | 55.8 | 1 30.9 | 0.83 |
| 6 | 5 35 | 6 22 | 4 46 | 11 0 52 | 9.0 | 6 19 3 | 56.1 | 1 50.8 | 0.83 |
| 7 | 5 36 | 6 20 | sets | 11 4 29 | 9.0 | 5 56 34 | 56.3 | 2 11.0 | 0.84 |
| 8 | 5 37 | 6 18 | 6 46 | 11 8 5 | 9.0 | 5 33 59 | 56.6 | 2 31.3 | 0.85 |
| 9 | 5 38 | 6 16 | 7 14 | 11 11 41 | 9.0 | 5 11 18 | 56.8 | 2 51.8 | 0.86 |
| 10 | 5 39 | 6 15 | 7 45 | 11 15 17 | 9.0 | 4 48 32 | 57.0 | 3 12.4 | 0.86 |
| 11 | 5 40 | 6 14 | 8 20 | 11 18 53 | 9.0 | 4 25 42 | 57.2 | 3 33.2 | 0.87 |
| 12 | 5 40 | 6 12 | 9 00 | 11 22 28 | 9.0 | 4 2 46 | 57.4 | 3 54.1 | 0.87 |
| 13 | 5 41 | 6 11 | 9 48 | 11 26 4 | 9.0 | 3 39 47 | 57.5 | 4 15.1 | 0.88 |
| 14 | 5 42 | 6 09 | 10 43 | 11 29 39 | 9.0 | 3 16 44 | 57.7 | 4 36.2 | 0.88 |
| 15 | 5 43 | 6 07 | 11 41 | 11 33 14 | 9.0 | 2 53 37 | 57.8 | 4 57.3 | 0.88 |
| 16 | 5 44 | 6 05 | morn | 11 36 50 | 9.0 | 2 30 27 | 58.0 | 5 18.5 | 0.88 |
| 17 | 5 45 | 6 03 | 0 42 | 11 40 25 | 9.0 | 2 7 14 | 58.1 | 5 39.7 | 0.88 |
| 18 | 5 46 | 6 02 | 1 44 | 11 44 0 | 9.0 | 1 43 59 | 58.2 | 6 0.9 | 0.88 |
| 19 | 5 47 | 6 00 | 2 44 | 11 47 36 | 9.0 | 1 20 41 | 58.3 | 6 22.1 | 0.88 |
| 20 | 5 48 | 5 59 | 3 44 | 11 51 11 | 9.0 | 0 57 22 | 58.3 | 6 43.3 | 0.88 |
| 21 | 5 49 | 5 58 | 4 42 | 11 54 46 | 9.0 | 0 34 1 | 58.4 | 7 4.4 | 0.88 |
| 22 | 5 40 | 5 56 | rises | 11 58 22 | 9.0 | N. 0 10 39 | 58.4 | 7 25.4 | 0.87 |
| 23 | 5 51 | 5 55 | 6 22 | 12 1 57 | 9.0 | S. 0 12 44 | 58.5 | 7 46.3 | 0.87 |
| 24 | 5 52 | 5 54 | 6 47 | 12 5 33 | 9.0 | 0 36 8 | 58.5 | 8 7.1 | 0.86 |
| 25 | 5 52 | 5 52 | 7 17 | 12 9 9 | 9.0 | 0 59 32 | 58.5 | 8 27.6 | 0.85 |
| 26 | 5 53 | 5 51 | 7 53 | 12 12 45 | 9.0 | 1 22 56 | 58.5 | 8 48.1 | 0.85 |
| 27 | 5 54 | 5 49 | 8 38 | 12 16 21 | 9.0 | 1 46 20 | 58.5 | 9 8.3 | 0.84 |
| 28 | 5 54 | 5 48 | 9 34 | 12 19 58 | 9.0 | 2 9 44 | 58.4 | 9 28.3 | 0.83 |
| 29 | 5 55 | 5 46 | 10 39 | 12 23 35 | 9.0 | 2 33 6 | 58.4 | 9 48.0 | 0.82 |
| 30 | 5 56 | 5 44 | 11 49 | 12 27 12 | 9.0 | 2 56 27 | 58.3 | 10 7.5 | 0.80 |

# OCTOBER, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Large. | Small. | Large. | Small. | Large. | Small. | Large. | Small. |
| | | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. | P.M. | P.M. |
| Mon..... | 1 | 6 33 | 8 01 | 5 00 | 6 30 | 7 19 | 8 03 | 1 00 | 9 06 |
| Tues..... | 2 | 7 56 | 9 05 | 6 05 | 7 00 | 8 34 | 9 15 | 1 53 | 10 40 |
| Wed..... | 3 | 8 56 | 9 58 | 7 10 | 7 40 | 9 47 | 10 19 | 2 40 | A.M. |
| Thur..... | 4 | 9 57 | 10 38 | 8 00 | 8 15 | 10 52 | 11 11 | 3 15 | 0 15 |
| Frid..... | 5 | small | large | small | large | small | large | 3 34 | 1 46 |
| Sat..... | 6 | 11 46 | 11 33 | 9 25 | 9 00 | A.M. | P.M. | 3 45 | 3 07 |
| **Sun**..... | 7 | A.M. | P.M. | 10 10 | 9 20 | 0 40 | 0 59 | 4 00 | 4 28 |
| Mon..... | 8 | 0 37 | 0 32 | 11 00 | 9 25 | 1 30 | 1 25 | 4 19 | 5 36 |
| Tues..... | 9 | 1 37 | 1 03 | 11 45 | 10 15 | 2 18 | 1 55 | 4 39 | 6 52 |
| Wed..... | 10 | 2 42 | 1 41 | A.M. | 10 50 | 3 07 | 2 29 | 5 01 | 8 07 |
| Thur..... | 11 | 3 53 | 2 30 | 0 30 | 11 25 | 4 01 | 3 17 | small | large |
| Frid..... | 12 | 5 03 | 3 28 | 2 12 | P.M. | 5 00 | 4 16 | 6 14 | 10 25 |
| Sat..... | 13 | 6 07 | 4 28 | 4 15 | 1 20 | 6 01 | 5 16 | 7 08 | 11 21 |
| **Sun**..... | 14 | 7 05 | 5 32 | 6 10 | 3 00 | 7 04 | 6 17 | 8 14 | P.M. |
| Mon..... | 15 | 7 55 | 6 31 | 7 00 | 4 45 | 8 02 | 7 19 | 9 29 | 0 43 |
| Tues..... | 16 | 8 42 | 7 27 | 7 25 | 5 50 | 8 56 | 8 19 | 10 43 | 1 16 |
| Wed..... | 17 | 9 23 | 8 25 | 7 50 | 6 40 | 9 44 | 9 17 | A.M. | 1 46 |
| Thur..... | 18 | large | small | large | small | large | small | 0 01 | 2 13 |
| Frid..... | 19 | 10 26 | 10 09 | 8 15 | 7 50 | 11 06 | 11 01 | 1 15 | 2 38 |
| Sat..... | 20 | 10 48 | 10 59 | 8 30 | 8 35 | 11 39 | 11 47 | 2 28 | 2 55 |
| **Sun**..... | 21 | 11 08 | 11 46 | 8 48 | 9 15 | P.M. | A.M. | 3 38 | 3 08 |
| Mon..... | 22 | 11 33 | A.M. | 9 03 | 10 00 | 0 24 | 0 33 | 4 42 | 3 21 |
| Tues..... | 23 | P.M. | 0 33 | 9 25 | 10 37 | 0 50 | 1 17 | 5 44 | 3 36 |
| Wed..... | 24 | 0 27 | 1 16 | 9 58 | 11 35 | 1 16 | 2 01 | 6 49 | 3 52 |
| Thur..... | 25 | 1 05 | 2 23 | 10 35 | A.M. | 1 53 | 2 47 | 7 53 | 4 14 |
| Frid..... | 26 | 1 52 | 3 20 | 11 20 | 1 15 | 2 41 | 3 35 | large | small |
| Sat..... | 27 | 2 48 | 4 20 | P.M. | 3 15 | 3 38 | 4 31 | 9 50 | 5 30 |
| **Sun**..... | 28 | 3 53 | 5 25 | 1 30 | 4 45 | 4 43 | 5 31 | 10 42 | 6 43 |
| Mon..... | 29 | 5 09 | 6 27 | 3 00 | 5 30 | 5 52 | 6 35 | 11 29 | 8 07 |
| Tues..... | 30 | 6 25 | 7 25 | 4 30 | 6 15 | 7 10 | 7 36 | P.M. | 9 37 |
| Wed..... | 31 | 7 38 | 8 18 | 6 00 | 6 45 | 8 24 | 8 36 | 0 44 | 11 11 |

# OCTOBER, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *subtracted* from Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 5 57 | 5 43 | morn | 12 30 49 | 9.1 | S. 3 19 46 | 58.3 | 10 26.6 | 0.79 |
| 2 | 5 58 | 5 41 | 1 06 | 12 34 27 | 9.1 | 3 43 3 | 58.2 | 10 45.4 | 0.78 |
| 3 | 5 59 | 5 39 | 2 21 | 12 38 5 | 9.1 | 4 6 18 | 58.0 | 11 4.0 | 0.76 |
| 4 | 6 00 | 5 37 | 3 35 | 12 41 43 | 9.1 | 4 29 30 | 57.9 | 11 22.1 | 0.75 |
| 5 | 6 01 | 5 35 | 4 49 | 12 45 22 | 9.1 | 4 52 39 | 57.8 | 11 39.9 | 0.73 |
| 6 | 6 02 | 5 34 | sets | 12 49 1 | 9.1 | 5 15 44 | 57.6 | 11 57.4 | 0.72 |
| 7 | 6 03 | 5 33 | 5 41 | 12 52 40 | 9.2 | 5 38 45 | 57.4 | 12 14.4 | 0.70 |
| 8 | 6 04 | 5 32 | 6 14 | 12 56 20 | 9.2 | 6 1 42 | 57.3 | 12 31.0 | 0.68 |
| 9 | 6 05 | 5 30 | 6 52 | 13 0 1 | 9.2 | 6 24 34 | 57.1 | 12 47.1 | 0.66 |
| 10 | 6 07 | 5 29 | 7 39 | 13 3 41 | 9.2 | 6 47 21 | 56.8 | 13 2.8 | 0.64 |
| 11 | 6 06 | 5 28 | 8 32 | 13 7 23 | 9.2 | 7 10 2 | 56.6 | 13 18.1 | 0.62 |
| 12 | 6 07 | 5 26 | 9 29 | 13 11 4 | 9.2 | 7 32 37 | 56.3 | 13 32.8 | 0.60 |
| 13 | 6 08 | 5 24 | 10 31 | 13 14 47 | 9.3 | 7 55 6 | 56.1 | 13 47.1 | 0.58 |
| 14 | 6 09 | 5 23 | 11 32 | 13 18 29 | 9.3 | 8 17 29 | 55.8 | 14 0.9 | 0.56 |
| 15 | 6 10 | 5 22 | morn | 13 22 13 | 9.3 | 8 39 44 | 55.5 | 14 14.1 | 0.54 |
| 16 | 6 11 | 5 21 | 0 35 | 13 25 57 | 9.3 | 9 1 51 | 55.1 | 14 26.8 | 0.52 |
| 17 | 6 12 | 5 19 | 1 35 | 13 29 41 | 9.4 | 9 23 51 | 54.8 | 14 38.9 | 0.49 |
| 18 | 6 13 | 5 17 | 2 33 | 13 33 26 | 9.4 | 9 45 43 | 54.5 | 14 50.4 | 0.47 |
| 19 | 6 14 | 5 16 | 3 31 | 13 37 12 | 9.4 | 10 7 26 | 54.1 | 15 1.3 | 0.44 |
| 20 | 6 15 | 5 15 | 4 29 | 13 40 58 | 9.4 | 10 29 0 | 53.7 | 15 11.6 | 0.41 |
| 21 | 6 16 | 5 13 | 5 28 | 13 44 45 | 9.5 | 10 50 25 | 53.3 | 15 21.3 | 0.39 |
| 22 | 6 17 | 5 12 | rises | 13 48 32 | 9.5 | 11 11 40 | 52.9 | 15 30.2 | 0.36 |
| 23 | 6 18 | 5 10 | 5 54 | 13 52 20 | 9.5 | 11 32 45 | 52.5 | 15 38.5 | 0.33 |
| 24 | 6 19 | 5 09 | 6 37 | 13 56 9 | 9.6 | 11 53 40 | 52.0 | 15 46.1 | 0.30 |
| 25 | 6 20 | 5 08 | 7 29 | 13 59 59 | 9.6 | 12 14 24 | 51.6 | 15 53.0 | 0.27 |
| 26 | 6 21 | 5 07 | 8 31 | 14 3 49 | 9.6 | 12 34 57 | 51.1 | 15 59.2 | 0.24 |
| 27 | 6 23 | 5 06 | 9 41 | 14 7 41 | 9.6 | 12 55 18 | 50.6 | 16 4.6 | 0.21 |
| 28 | 6 24 | 5 05 | 10 53 | 14 11 33 | 9.7 | 13 15 27 | 50.1 | 16 9.2 | 0.18 |
| 29 | 6 25 | 5 03 | morn | 14 15 25 | 9.7 | 13 35 24 | 49.6 | 16 13.1 | 0.14 |
| 30 | 6 26 | 5 02 | 0 07 | 14 19 19 | 9.7 | 13 55 8 | 49.0 | 16 16.2 | 0.11 |
| 31 | 6 27 | 5 01 | 1 19 | 14 23 13 | 9.8 | 14 14 39 | 48.5 | 16 18.4 | 0.08 |

# NOVEMBER, 1877.

| Day of Week. | Day of Month. | San Francisco. HIGH WATER. | | San Diego. HIGH WATER. | | Astoria. HIGH WATER. | | Port Townsend. HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Small. | Large. | Small. | Large. | Small. | Large. | Large. | Small. |
| | | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. | P.M. | |
| Thur. | 1 | 8 47 | 9 04 | 7 10 | 7 05 | 9 34 | 9 32 | 1 22 | A.M. |
| Frid. | 2 | 9 50 | 9 46 | 7 50 | 7 30 | 10 40 | 10 24 | 1 55 | 0 45 |
| Sat. | 3 | 10 50 | 10 23 | 8 25 | 8 00 | 11 40 | 11 08 | 2 21 | 2 14 |
| **Sun.** | 4 | 11 46 | 10 51 | 9 00 | 8 35 | A.M. | 11 44 | 2 42 | 3 39 |
| Mon. | 5 | A.M. | 11 20 | 9 45 | 8 50 | 0 33 | P.M. | 3 02 | 5 05 |
| Tues. | 6 | 0 42 | 11 54 | 10 35 | 9 15 | 1 22 | 0 54 | 3 21 | 6 16 |
| Wed. | 7 | 1 39 | P.M. | 11 55 | 9 45 | 2 10 | 1 27 | 3 47 | 7 16 |
| Thur. | 8 | 2 38 | 1 14 | A.M. | 10 15 | 3 01 | 2 04 | small | large |
| Frid. | 9 | 3 36 | 2 03 | 1 30 | 11 00 | 3 51 | 2 51 | 4 40 | 9 03 |
| Sat. | 10 | 4 30 | 3 09 | 3 10 | P.M. | 4 41 | 3 49 | 5 31 | 9 42 |
| **Sun.** | 11 | 5 22 | 3 56 | 4 15 | 1 00 | 5 30 | 4 42 | 6 41 | 10 21 |
| Mon. | 12 | 6 11 | 4 53 | 5 00 | 2 10 | 6 20 | 5 41 | 8 04 | 10 56 |
| Tues. | 13 | 6 56 | 5 52 | 5 35 | 3 30 | 7 10 | 6 41 | 9 22 | 11 27 |
| Wed. | 14 | large | small | large | small | large | small | 10 43 | 11 56 |
| Thur. | 15 | 8 13 | 7 53 | 6 30 | 6 00 | 8 43 | 8 44 | 11 56 | P.M. |
| Frid. | 16 | 8 46 | 8 54 | 7 00 | 6 58 | 9 24 | 9 42 | A.M. | 0 55 |
| Sat. | 17 | 9 20 | 9 56 | 7 20 | 7 45 | 10 03 | 10 40 | 1 11 | 1 24 |
| **Sun.** | 18 | 9 51 | 10 47 | 7 40 | 8 30 | 10 40 | 11 35 | 2 26 | 1 47 |
| Mon. | 19 | 10 23 | 11 42 | 8 00 | 9 10 | 11 16 | A.M. | 3 40 | 2 08 |
| Tues. | 20 | 10 52 | A.M. | 8 24 | 9 55 | 11 55 | 0 23 | 4 53 | 2 28 |
| Wed. | 21 | 11 25 | 0 37 | 8 50 | 10 45 | P.M. | 1 11 | 6 05 | 2 49 |
| Thur. | 22 | P.M. | 1 32 | 9 20 | 11 45 | 1 17 | 1 55 | large | small |
| Frid. | 23 | 0 47 | 2 28 | 10 00 | A.M. | 1 57 | 2 41 | 7 54 | 3 35 |
| Sat. | 24 | 1 44 | 3 21 | 11 00 | 0 55 | 2 41 | 3 29 | 8 35 | 4 40 |
| **Sun.** | 25 | 2 42 | 4 10 | P.M. | 2 10 | 3 30 | 4 17 | 9 15 | 5 51 |
| Mon. | 26 | 3 45 | 5 00 | 1 00 | 3 05 | 4 34 | 5 08 | 9 54 | 7 00 |
| Tues. | 27 | 4 55 | 5 52 | 2 15 | 4 00 | 5 43 | 6 03 | 10 29 | 8 29 |
| Wed. | 28 | small | large | small | large | small | large | 11 03 | 10 11 |
| Thur. | 29 | 7 26 | 7 27 | 5 00 | 5 51 | 8 01 | 7 57 | 11 33 | 11 37 |
| Frid. | 30 | 8 40 | 8 13 | 6 15 | 6 30 | 9 13 | 8 51 | P.M. | A.M. |

# NOVEMBER, 1877.

| Day of Month. | *San Francisco.* Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *subtracted* from Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 6 28 | 5 00 | 2 31 | 14 27 8 | 9.8 | S. 14 33 56 | 47.9 | 16 19.8 | 0.04 |
| 2 | 6 29 | 4 59 | 3 41 | 14 31 4 | 9.8 | 14 52 59 | 47.3 | 16 20.5 | 0.01 |
| 3 | 6 30 | 4 58 | 4 52 | 14 35 1 | 9.9 | 15 11 48 | 46.7 | 16 20.3 | 0.03 |
| 4 | 6 31 | 4 57 | 6 03 | 14 38 58 | 9.9 | 15 30 21 | 46.1 | 16 19.3 | 0.06 |
| 5 | 6 32 | 4 56 | sets | 14 42 57 | 9.9 | 15 48 39 | 45.4 | 16 17.4 | 0.10 |
| 6 | 6 33 | 4 55 | 5 28 | 14 46 56 | 10.0 | 16 6 42 | 44.8 | 16 14.7 | 0.13 |
| 7 | 6 34 | 4 54 | 6 19 | 14 50 56 | 10.0 | 16 24 28 | 44.1 | 16 11.2 | 0.17 |
| 8 | 6 35 | 4 53 | 7 16 | 14 54 57 | 10.1 | 16 51 58 | 43.4 | 16 6.8 | 0.20 |
| 9 | 6 36 | 4 52 | 8 17 | 14 58 59 | 10.1 | 16 59 11 | 42.7 | 16 1.6 | 0.23 |
| 10 | 6 37 | 4 51 | 9 20 | 15 3 1 | 10.1 | 17 16 6 | 41.9 | 15 55.6 | 0.27 |
| 11 | 6 38 | 4 50 | 10 23 | 15 7 5 | 10.2 | 17 32 43 | 41.2 | 15 48.7 | 0.30 |
| 12 | 6 39 | 4 49 | 11 23 | 15 11 9 | 10.2 | 17 49 2 | 40.4 | 15 41.0 | 0.34 |
| 13 | 6 40 | 4 49 | morn | 15 15 14 | 10.2 | 18 5 2 | 39.6 | 15 32.5 | 0.37 |
| 14 | 6 41 | 4 48 | 0 22 | 15 19 20 | 10.3 | 18 20 44 | 38.8 | 15 23.1 | 0.41 |
| 15 | 6 42 | 4 47 | 1 19 | 15 23 27 | 10.3 | 18 36 5 | 38.0 | 15 12.9 | 0.44 |
| 16 | 6 43 | 4 46 | 2 17 | 15 27 35 | 10.3 | 18 51 8 | 37.2 | 15 1.9 | 0.48 |
| 17 | 6 44 | 4 46 | 3 16 | 15 31 43 | 10.4 | 19 5 50 | 36.3 | 14 50.1 | 0.51 |
| 18 | 6 45 | 4 45 | 4 26 | 15 35 52 | 10.4 | 19 20 11 | 35.4 | 14 37.4 | 0.54 |
| 19 | 6 46 | 4 44 | 5 18 | 15 40 2 | 10.4 | 19 34 11 | 34.6 | 14 23.9 | 0.58 |
| 20 | 6 47 | 4 43 | rises | 15 44 13 | 10.5 | 19 47 50 | 33.7 | 14 9.7 | 0.61 |
| 21 | 6 49 | 4 43 | 5 23 | 15 48 25 | 10.5 | 20 1 8 | 32.8 | 13 54.6 | 0.65 |
| 22 | 6 50 | 4 42 | 6 23 | 15 52 37 | 10.5 | 20 14 4 | 31.8 | 13 38.7 | 0.68 |
| 23 | 6 51 | 4 42 | 7 31 | 15 56 51 | 10.6 | 20 26 37 | 30.9 | 13 22.0 | 0.71 |
| 24 | 6 52 | 4 42 | 8 44 | 16 1 5 | 10.6 | 20 38 48 | 30.0 | 13 4.6 | 0.74 |
| 25 | 6 53 | 4 41 | 9 58 | 16 5 20 | 10.6 | 20 50 36 | 29.0 | 12 46.3 | 0.78 |
| 26 | 6 55 | 4 41 | 11 10 | 16 9 35 | 10.7 | 21 2 1 | 28.0 | 12 27.3 | 0.81 |
| 27 | 6 56 | 4 41 | morn | 16 13 52 | 10.7 | 21 13 1 | 27.0 | 12 7.5 | 0.84 |
| 28 | 6 57 | 4 41 | 0 21 | 16 18 9 | 10.7 | 21 23 38 | 26.0 | 11 47.0 | 0.87 |
| 29 | 6 58 | 4 40 | 1 29 | 16 22 27 | 10.8 | 21 33 51 | 25.0 | 11 25.8 | 0.90 |
| 30 | 6 59 | 4 40 | 2 38 | 16 26 45 | 10.8 | 21 43 39 | 24.0 | 11 3.9 | 0.93 |

# DECEMBER, 1877.

| Day of Week. | Day of Month. | *San Francisco.* HIGH WATER. | | *San Diego.* HIGH WATER. | | *Astoria.* HIGH WATER. | | *Port Townsend.* HIGH WATER. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Small. | Large. | Small. | Large. | Small. | Large. | Large. | Small. |
| | | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. | P.M. | A.M. |
| Sat..... | 1 | 9 49 | 8 56 | 7 30 | 6 55 | 10 25 | 9 40 | 0 43 | 1 07 |
| Sun..... | 2 | 10 50 | 9 37 | 8 45 | 7 20 | 11 30 | 10 25 | 1 12 | 2 37 |
| Mon..... | 3 | 11 53 | 10 13 | 9 45 | 7 50 | A.M. | 11 07 | 1 38 | 4 09 |
| Tues..... | 4 | A.M. | 10 46 | 10 40 | 8 25 | 0 27 | 11 49 | 2 04 | 5 33 |
| Wed..... | 5 | 0 53 | 11 26 | 11 30 | 8 55 | 1 20 | P.M. | small | large |
| Thur..... | 6 | 1 27 | P.M. | A.M. | 9 25 | 2 09 | 1 11 | 3 08 | 7 27 |
| Frid..... | 7 | 2 34 | 0 50 | 0 20 | 10 00 | 2 50 | 1 54 | 3 46 | 7 57 |
| Sat..... | 8 | 3 13 | 1 38 | 1 15 | 10 50 | 3 31 | 2 37 | 4 32 | 8 24 |
| Sun..... | 9 | 3 49 | 2 24 | 2 12 | 11 30 | 4 09 | 3 16 | 5 25 | 8 46 |
| Mon..... | 10 | 4 25 | 3 12 | 2 50 | P.M. | 4 47 | 4 20 | 6 28 | 9 10 |
| Tues..... | 11 | 5 04 | 4 09 | 3 35 | 1 05 | 5 26 | 4 54 | 7 42 | 9 36 |
| Wed..... | 12 | large | small | large | small | large | small | 9 01 | 10 02 |
| Thur .... | 13 | 6 18 | 6 13 | 5 15 | 3 20 | 6 41 | 6 52 | 10 27 | 10 26 |
| Frid..... | 14 | 6 55 | 7 17 | 5 50 | 5 10 | 7 25 | 8 00 | 11 53 | 10 56 |
| Sat..... | 15 | 7 35 | 8 27 | 6 23 | 6 35 | 8 10 | 9 05 | A.M. | 11 25 |
| Sun..... | 16 | 8 17 | 9 34 | 6 45 | 7 45 | 8 57 | 10 08 | 1 17 | 11 57 |
| Mon..... | 17 | 8 58 | 10 42 | 7 05 | 8 40 | 9 50 | 11 10 | 2 42 | P.M. |
| Tues..... | 18 | 9 40 | 11 44 | 7 35 | 9 32 | 10 40 | A.M. | 4 06 | 1 00 |
| Wed..... | 19 | 10 23 | A.M. | 8 10 | 10 20 | 11 30 | 0 07 | 5 23 | 1 31 |
| Thur..... | 20 | 11 11 | 0 42 | 8 45 | 11 00 | P.M. | 1 03 | large | small |
| Frid..... | 21 | 11 56 | 1 37 | 9 25 | 11 45 | 0 58 | 1 55 | 6 55 | 2 37 |
| Sat..... | 22 | P.M. | 2 22 | 10 15 | A.M. | 1 40 | 2 39 | 7 25 | 3 25 |
| Sun..... | 23 | 1 32 | 2 59 | 11 00 | 0 35 | 2 27 | 3 19 | 7 54 | 4 37 |
| Mon..... | 24 | 2 29 | 3 34 | P.M. | 1 30 | 3 21 | 4 00 | 8 21 | 6 00 |
| Tues..... | 25 | small | large | small | large | small | large | 8 48 | 7 26 |
| Wed..... | 26 | 4 50 | 4 52 | 1 50 | 3 30 | 5 23 | 5 23 | 9 13 | 8 52 |
| Thur .... | 27 | 6 05 | 5 40 | 3 00 | 4 15 | 6 35 | 6 12 | 9 46 | 10 00 |
| Frid..... | 28 | 7 20 | 6 31 | 4 55 | 5 00 | 7 48 | 7 03 | 10 22 | A.M. |
| Sat..... | 29 | 8 40 | 7 18 | 6 30 | 5 38 | 9 03 | 7 57 | 10 56 | 0 01 |
| Sun..... | 30 | 9 56 | 8 09 | 8 00 | 6 20 | 10 15 | 8 53 | 11 35 | 1 39 |
| Mon..... | 31 | 11 06 | 9 00 | 9 05 | 7 10 | 11 25 | 9 53 | P.M. | 3 16 |

# DECEMBER, 1877.

| Day of Month. | San Francisco. Sun rises. | Sun sets. | Moon rises. | The Sun's Right Ascension at Greenwich, Apparent Noon. | Diff. for One Hour. | The Sun's Declination at Greenwich, Apparent Noon. | Diff. for One Hour. | Equation of Time, to be *subtracted* from / *added* to Apparent Time. | Diff. for One Hour. |
|---|---|---|---|---|---|---|---|---|---|
| | H. M. | H. M. | H. M. | H. M. S. | S. | ° ′ ″ | ″ | M. S. | S. |
| 1 | 7 00 | 4 40 | 3 48 | 16 31 4 | 10.8 | S. 21 53 2 | 22.9 | 10 41.3 | 0.95 |
| 2 | 7 01 | 4 40 | 4 57 | 16 35 24 | 10.8 | 22 2 0 | 21.9 | 10 18.0 | 0.98 |
| 3 | 7 01 | 4 40 | 6 06 | 16 39 45 | 10.9 | 22 10 32 | 20.8 | 9 54.2 | 1.01 |
| 4 | 7 02 | 4 40 | sets | 16 44 6 | 10.9 | 22 18 38 | 19.7 | 9 29.7 | 1.03 |
| 5 | 7 03 | 4 40 | 5 01 | 16 48 27 | 10.9 | 22 26 19 | 18.6 | 9 4.7 | 1.05 |
| 6 | 7 04 | 4 39 | 6 01 | 16 52 50 | 10.9 | 22 33 33 | 17.5 | 8 39.1 | 1.08 |
| 7 | 7 05 | 4 39 | 7 04 | 16 57 12 | 11.0 | 22 40 20 | 16.4 | 8 13.0 | 1.10 |
| 8 | 7 06 | 4 39 | 8 09 | 17 1 36 | 11.0 | 22 46 41 | 15.3 | 7 46.4 | 1.12 |
| 9 | 7 07 | 4 39 | 9 11 | 17 5 59 | 11.0 | 22 52 35 | 14.2 | 7 19.4 | 1.13 |
| 10 | 7 07 | 4 39 | 10 11 | 17 10 23 | 11.0 | 22 58 1 | 13.0 | 6 52.0 | 1.15 |
| 11 | 7 08 | 4 38 | 11 08 | 17 14 48 | 11.0 | 23 3 1 | 11.9 | 6 24.2 | 1.16 |
| 12 | 7 09 | 4 40 | morn | 17 19 12 | 11.0 | 23 7 33 | 10.8 | 5 56.1 | 1.18 |
| 13 | 7 10 | 4 40 | 0 06 | 17 23 37 | 11.1 | 23 11 37 | 9.6 | 5 27.6 | 1.19 |
| 14 | 7 10 | 4 40 | 1 03 | 17 28 3 | 11.1 | 23 15 14 | 8.4 | 4 58.9 | 1.20 |
| 15 | 7 11 | 4 40 | 2 02 | 17 32 29 | 11.1 | 23 18 22 | 7.3 | 4 29.9 | 1.21 |
| 16 | 7 11 | 4 41 | 3 02 | 17 36 54 | 11.1 | 23 21 3 | 6.1 | 4 0.7 | 1.22 |
| 17 | 7 12 | 4 41 | 4 05 | 17 41 20 | 11.1 | 23 23 16 | 4.9 | 3 31.2 | 1.23 |
| 18 | 7 12 | 4 41 | 5 10 | 17 45 47 | 11.1 | 23 25 0 | 3.8 | 3 1.7 | 1.23 |
| 19 | 7 13 | 4 42 | rises | 17 50 13 | 11.1 | 23 26 17 | 2.7 | 2 32.0 | 1.24 |
| 20 | 7 14 | 4 42 | 5 14 | 17 54 39 | 11.1 | 23 27 5 | 1.4 | 2 2.2 | 1.24 |
| 21 | 7 15 | 4 43 | 6 29 | 17 59 6 | 11.1 | 23 27 25 | 0.2 | 1 32.3 | 1.24 |
| 22 | 7 15 | 4 43 | 7 45 | 18 3 33 | 11.1 | 23 27 17 | 0.9 | 1 2.4 | 1.25 |
| 23 | 7 16 | 4 44 | 9 00 | 18 7 59 | 11.1 | 23 26 40 | 2.1 | 0 32.4 | 1.25 |
| 24 | 7 16 | 4 44 | 10 12 | 18 12 26 | 11.1 | 23 25 35 | 3 3 | 0 2.5 | 1.24 |
| 25 | 7 16 | 4 45 | 11 22 | 18 16 52 | 11.1 | 23 24 2 | 4.5 | 0 27.3 | 1.24 |
| 26 | 7 17 | 4 45 | morn | 18 21 19 | 11.1 | 23 22 0 | 5.6 | 0 57.1 | 1.24 |
| 27 | 7 17 | 4 46 | 0 31 | 18 25 45 | 11.1 | 23 19 31 | 6.8 | 1 26.7 | 1.23 |
| 28 | 7 17 | 4 46 | 1 39 | 18 30 11 | 11.1 | 23 16 33 | 8.0 | 1 56.2 | 1.23 |
| 29 | 7 17 | 4 47 | 2 47 | 18 34 37 | 11.1 | 23 13 7 | 9.2 | 2 25.6 | 1.22 |
| 30 | 7 17 | 4 48 | 3 55 | 18 39 3 | 11.1 | 23 9 13 | 10.3 | 2 54.7 | 1.21 |
| 31 | 7 18 | 4 49 | 5 01 | 18 43 28 | 11.0 | 23 4 51 | 11.5 | 3 23.5 | 1.20 |

## TO FIND THE TIME OF THE TWO LOW WATERS,

*At San Francisco, San Diego, Astoria, Port Townsend, and Intermediate Points.*

Turn to the Almanac for the required locality and day; and if the headings over the High Waters at the preceding change of tide are in the order *Large—Small*, the Moon's declination is North, and Table A is to be used. Count the number of days from the headings downward until the required day is reached; then add the time of High Water in the first column of the Almanac to the hours and minutes indicated for the same day in Table A, and the product will be the Low Water *large* next succeeding. To the time of High Water *small* of the same day, in the second column of the Almanac, add the hours and minutes given in Table B, and the product will be Low Water *small*. If the headings over the High Waters are in the order *Small—Large*, the Moon's declination is South, and the tables are to be transposed by adding the quantities in Table B to the time of High Water in the first column of the Almanac, and the quantities in Table A to the second column.

Attention must be paid to the A. M. and P. M. headings, as the product will sometimes run into the morning of the following day. Should the locality be other than one of the four principal ports, turn to the Table of Tidal Constants and apply the proper correction. Where the changes of tide occur, the tides are omitted for those days to make room for the headings; in such cases they can be estimated very closely by proportion. The term *Large* indicates an *extreme* tide either of High or Low Water; the term *Small* indicates a *medium* tide.

| San Francisco. | | | San Diego. | | | Astoria. | | | Port Townsend. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Days. | A | B | Days. | A | B | Days. | A | B | Days. | A | B |
| | H. M. | H. M. | | H. M. | H. M. | | H. M. | H. M. | | H. M. | H. M. |
| 1 | 6 06 | 5 36 | 1 | 6 42 | 5 18 | 1 | 6 42 | 6 14 | 1 | 5 06 | 6 38 |
| 2 | 6 28 | 5 14 | 2 | 7 00 | 5 00 | 2 | 7 01 | 5 55 | 2 | 4 26 | 7 18 |
| 3 | 6 47 | 4 55 | 3 | 7 13 | 4 47 | 3 | 7 22 | 5 34 | 3 | 3 31 | 8 13 |
| 4 | 7 05 | 4 37 | 4 | 7 26 | 4 34 | 4 | 7 36 | 5 20 | 4 | 3 08 | 8 36 |
| 5 | 7 18 | 4 24 | 5 | 7 36 | 4 24 | 5 | 7 47 | 5 09 | 5 | 3 01 | 8 43 |
| 6 | 7 30 | 4 12 | 6 | 7 43 | 4 17 | 6 | 7 51 | 5 05 | 6 | 3 32 | 8 12 |
| 7 | 7 30 | 4 12 | 7 | 7 48 | 4 12 | 7 | 7 53 | 5 03 | 7 | 4 04 | 7 40 |
| 8 | 7 25 | 4 17 | 8 | 7 46 | 4 14 | 8 | 7 51 | 5 05 | 8 | 4 26 | 7 18 |
| 9 | 7 15 | 4 27 | 9 | 7 36 | 4 24 | 9 | 7 45 | 5 11 | 9 | 4 45 | 6 59 |
| 10 | 7 01 | 4 41 | 10 | 7 22 | 4 38 | 10 | 7 38 | 5 18 | 10 | 5 06 | 6 38 |
| 11 | 6 46 | 4 56 | 11 | 6 59 | 5 01 | 11 | 7 24 | 5 32 | 11 | 5 20 | 6 24 |
| 12 | 6 28 | 5 14 | 12 | 6 35 | 5 25 | 12 | 7 06 | 5 50 | 12 | 5 34 | 6 10 |
| 13 | 6 06 | 5 36 | 13 | 6 11 | 5 49 | 13 | 6 45 | 6 11 | 13 | 5 45 | 5 59 |

## TIDAL CONSTANTS.

### San Francisco Tide Table—(North Beach.)

To obtain the time of High Water at the following points, find the time for San Francisco : then for

| | | H. | M. |
|---|---|---|---|
| Fort Point | Subtract | 0 | 20 |
| Monterey | Subtract | 1 | 43 |
| Santa Cruz | Subtract | 1 | 38 |
| Half-Moon Bay | Subtract | 1 | 43 |
| South Farallon | Subtract | 1 | 27 |
| Saucelito | Subtract | 0 | 35 |
| Tomales Bay | Subtract | 0 | 08 |
| Bodega | Subtract | 1 | 02 |
| Drake's Bay | Subtract | 0 | 25 |
| Point Reyes | Subtract | 1 | 31 |
| Peralta (San Francisco Bay) | Subtract | 0 | 11 |
| Point Wilson (San Francisco Bay) | Add .... | 1 | 16 |
| Mare Island (San Francisco Bay) | Add .... | 1 | 33 |
| Benicia (San Francisco Bay) | Add .... | 2 | 04 |
| Army Point (San Francisco Bay) | Add .... | 1 | 54 |
| Collinsville (San Francisco Bay) | Add .... | 2 | 51 |
| Sacramento City | Add .... | 7 | 38 |
| Guano Island (San Francisco Bay) | Add .... | 0 | 08 |
| Ravenswood (San Francisco Bay) | Add .... | 0 | 30 |

NOTE.—The time of High Water on "San Francisco Bar" is about sixty-one minutes earlier than the computed time for San Francisco (North Beach); and at the "Heads" about forty minutes earlier. At the "Heads" the *current* changes from half an hour to one and a half hours after the change of tide; but during great freshets in the Bay, the mid-channel surface-current sometimes runs ebb during the whole of the flood tide.

### San Diego Tide Table—(Near La Playa.)

To obtain the time of High Water at the following points, find the time for San Diego: then for

| | | H. | M. |
|---|---|---|---|
| Cape St. Lucas | Subtract | 0 | 53 |
| Margarita Island (Magdalena Bay) | Subtract | 1 | 17 |
| Man-of-War Cove (Magdalena Bay) | Subtract | 1 | 13 |
| Cuyler's Harbor | Subtract | 0 | 10 |
| Santa Barbara | Subtract | 0 | 04 |
| San Pedro | Add .... | 0 | 06 |
| Point Sal | Add .... | 0 | 29 |
| San Luis Obispo | Add .... | 0 | 35 |

### Astoria Tide Table.

To obtain the time of High Water at the following points, find the time for Astoria : then for

| | | H. | M. |
|---|---|---|---|
| Humboldt Bay (Humboldt Point) | Subtract | 0 | 22 |
| Humboldt Bay (Red Bluff) | Subtract | 0 | 42 |
| Crescent City | Subtract | 1 | 04 |
| Trinidad Harbor | Subtract | 1 | 07 |
| Port Orford | Subtract | 0 | 50 |
| Coquille River | Subtract | 1 | 12 |
| Coos Bay (Pigeon Point) | Subtract | 0 | 21 |
| Coos Bay (north bend) | Add .... | 0 | 56 |
| Yaquina Bay | Subtract | 0 | 27 |
| Oysterville (Yaquina River) | Subtract | 0 | 02 |
| Tillamook Bay | Subtract | 0 | 08 |
| Clatsop (near Point Adams) | Subtract | 0 | 07 |
| Cape Disappointment | Subtract | 0 | 10 |
| Shoalwater Bay | Add .... | 0 | 14 |
| Destruction Island | Subtract | 0 | 19 |
| Nee-ah Harbor | Add .... | 0 | 13 |
| Ahosette (Nootka Sound) | Subtract | 0 | 12 |
| Fort Stevens (Columbia River) | Add .... | 0 | 03 |
| Skipennon Creek (Columbia River) | Add .... | 0 | 09 |

| | | H. | M. |
|---|---|---|---|
| Tongue Point (Columbia River) | Add | 0 | 34 |
| Marsh Island Creek (Columbia River) | Add | 1 | 00 |
| Gray's Harbor | Subtract | 0 | 02 |
| Sitka | Add | 0 | 21 |

NOTE.—At the mouth of Columbia River the *current* changes from one-half hour to one hour after the change of tide; but during great freshets the ebb current lasts much longer than the ebb tide.

### Port Townsend, W. T., Tide Table.

To obtain the time of High Water at the following points, find the time for Port Townsend: then for

| | | H. | M. |
|---|---|---|---|
| New Dungeness | Subtract | 0 | 35 |
| Restoration Point | Add | 0 | 15 |
| Port Madison | Add | 0 | 26 |
| Shilhole Bay | Add | 0 | 29 |
| Steilacoom | Add | 0 | 58 |
| Semi-ah-moo Bay | Add | 1 | 07 |
| Olympia | Add | 0 | 56 |

## LIGHT-HOUSES ON THE WESTERN COAST.

Description of the buildings, that they may be recognized in the daytime.

**Point Loma.**—A low tower (dark gray) rising from keeper's dwelling (gray); lantern red; on the highest part of the point, and about half a mile from its extremity, and little less than one mile S. 12½ W. from Ballast Point, marking the approach to San Diego Harbor. This point may be passed in safety within three-fourths of a mile. After crossing the bar, keep La Playa a little open to the eastward of Ballast Point (which can be passed within 20 yards) to enter the harbor. The anchorage is off La Playa.

**Point Fermin.**—Square wooden tower (light buff), rising from keeper's dwelling (light buff); dome of lantern, red.

**Point Hueneme.**—Square wooden tower (light buff); rising from keeper's dwelling (light buff); dome of lantern, red.

**Santa Barbara.**—A low tower (gray) rising from keeper's dwelling (gray); lantern red; green shutters to windows.

**Point Conception.**—A low circular brick tower (white) rising from keeper's dwelling (white); lantern red.

**Piedras Blancas.**—A brick conical tower 90 feet high, with iron parapet and lantern.

**Point Pinos.**—A low brick tower (white), rising from keeper's dwelling (dark gray stone); lantern red.

**Santa Cruz.**—A small wooden tower (white), rising from keeper's dwelling (white with green blinds); lantern white with red dome.

**Pigeon Point.**—A conical brick tower (white); lantern black with

red dome; keeper's dwelling, two stories, of wood, painted white, with red roof. and standing north-westward of tower.

**South Farallon.**—Tower white, lantern red.

**Point Boneta.**—A low white tower, separate from keeper's dwelling.

**Point Reyes.**—A white tower of wrought iron, with sixteen sides; keeper's dwelling nearly white, and built 215 feet higher up the slope.

**Point Arena.**—A white conical brick tower; white lantern, with red dome; keeper's dwelling a large two-story brick building (white), standing 60 feet in the rear.

**Cape Mendocino.**—A white tower of wrought iron, polygon of 16 sides; lantern white, with red dome; keeper's dwelling of wood, standing 150 feet to the east-south-east of tower.

**Humboldt.**—White conical brick tower rising from keeper's dwelling.

**Trinidad Head.**—A brick tower, painted white, except the dome and railing, which are red; keeper's dwelling a two-story, of wood, painted white, and standing 50 yards to the northeast.

**Yaquina Head (Foulweather)**—A brick tower (white); lantern black; keeper's dwelling two-story (white), standing east of the tower.

**Crescent City.**—A low brick tower rising from keeper's dwelling.

**Cape Blanco.**—A white circular tower; keeper's dwelling a two-story brick building, also white, standing 100 feet to the south.

**Cape Arago (Gregory).**—A white conical iron tower; dome of lantern red; keeper's dwelling 300 yards distant to the north-east.

**Point Adams.**—A low, square tower of wood, painted light buff, rising from keeper's dwelling (light buff); lantern black, with red dome.

**Cape Disappointment.**—A low white tower rising from keeper's dwelling (white); lantern red.

**Shoalwater Bay.**—A low white tower rising from keeper's dwelling, both of brick.

**Cape Flattery.**—A brick tower (white), rising from keeper's dwelling (gray stone); lantern red.

**Ediz Hook.**—A square white tower on keeper's dwelling, dome of lantern red.

**New Dungeness.**—A brick tower, yellow sandstone, rising from keeper's dwelling.

**Smith's Island.**—A low white brick tower rising from keeper's dwelling; lantern red.

**Admiralty Head.**—A low square white tower rising from keeper's dwelling.

**Race Rocks.**—A stone tower, painted with alternate horizontal black and white bands; keeper's dwelling of stone.

## GEOGRAPHICAL POSITIONS

*Of Important Headlands, Light-Houses, etc., on the Western Coast.*

| Name of Station. | Locality. | Latitude North. | Longitude West. | Variation East. |
|---|---|---|---|---|
| | | ° ′ ″ | ° ′ ″ | ° ′ |
| Point Loma Light-House, 3 F W 24 | W side entrance to the bay, 450 feet high | 32 40 13 | 117 14 38 | ..... |
| Point Fermin Light House, 4 Fl R and W 10 secs, 19 | W side entrance to San Pedro Bay | 33 42 19 | 118 17 37 | ..... |
| Point Hueneme L. H., 4 F var by W Fl 10 secs, 13 | On mainland, Eastern ent. to Santa Barbara Chan'l. | 34 08 40 | 119 12 35 | 13 48 |
| Santa Barbara Light-House, 4 F W 17 | Two miles SW of landing, 180 feet | 34 23 35 | 119 43 05 | ..... |
| Point Conception Light-House, 1 Rv W Fl ½ M 23 | Point Conception, 250 feet | 34 26 47 | 120 27 00 | ..... |
| Piedras Blancas Light House, 1 F V W F 15 secs, 18½ | On the point, N W of entrance to San Simeon Bay | 35 39 45 | 121 15 46 | 14 58 |
| Point Pinos Light-House, 3 F W 16 | At NW point of the trees, 91 feet | 36 37 52 | 121 56 00 | ..... |
| Santa Cruz Light-House, 5 F W 14 | On Point Santa Cruz | 36 57 00 | 122 01 32 | ..... |
| Pigeon Point Light-House, 1 W Fl every 10 secs, 18½ | On Pigeon Point | 37 10 50 | 122 23 35 | ..... |
| South Farallon L. H., 1 Rv W Pr Fl every M 26 | 23½ miles SW by W ¼ W off ent. to S F Bay, 360 feet | 37 41 49 | 123 00 04 | ..... |
| Point Lobos | South head of entrance to San Francisco Bay | 37 46 50 | 122 29 39 | 15 18 |
| Point Boneta Light-House, 2 F W 24 | North head of entrance to San Francisco Bay, 150 ft. | 37 49 04 | 122 31 50 | ..... |
| Fort Point Light-House, 5 F W 15 | South side of entrance to San Francisco Bay, 83 feet | 37 48 31 | 122 28 38 | ..... |
| Alcatraz Island Light-House, 3 F W 19 | In the harbor of San Francisco, 166 feet | 37 49 27 | 122 25 19 | ..... |
| Yerba Buena Island Light-House, 5 F W | On SE extremity of the island | 37 47 55 | 122 21 16 | ..... |
| East Brother Island L. H., S. F. Bay, 4 Fl W 30 secs | On East Brother Island, off Point San Pablo | 37 57 39 | 122 26 01 | 16 08 |
| Mare Island Light House, 4 F W | Extreme East end of Mare Island | 38 04 17 | 122 15 19 | ..... |
| Point Reyes Light-House, 1 flashes every 5 secs, 23 | On western part of head. 296 feet | 37 59 39 | 123 00 16 | ..... |
| Point Arena Light-House, 1 F W 20 | Near NW extremity of the point, 156 feet | 38 57 10 | 123 43 47 | 17 24 |
| Cape Mendocino Light-House, 1 W Fl 30 secs, 27 | West slope of cape, 423 feet | 40 26 17 | 124 23 24 | ..... |
| Humboldt Light-House, 4 F W 12 | On the N point one mile from entrance, 53 feet | 40 46 04 | 124 12 21 | ..... |
| Trinidad Head Light-House, 4 F W Var by Red Flash | On Trinidad Head | 41 03 00 | 124 08 56 | ..... |
| Crescent City Light-House, 4 F W Var by Fl 14 | On the extreme W part of the point, 80 feet | 41 44 34 | 124 12 22 | 18 54 |
| Cape Blanco Light-House, 1 F W 22 | On the highest part of the Cape | 42 50 07 | 124 32 29 | ..... |
| Cape Gregory Light-House, 4 F W Var by Fl 15 | On small island at western extremity of Cape, 75 feet. | 43 20 38 | 124 22 20 | ..... |
| Cape Foulweather Light-House, 1 F W 18½ | Westerly of the Cape, 150 feet high | 44 43 30 | 124 05 00 | ..... |
| Point Adams Light-House, 4 Fl R and W, 10 secs | On low ridge, entrance to Columbia River | 46 11 36 | 123 57 40 | 21 05 |
| Cape Disappointment Light-House, 1 F W 22½ | Near the highest part of the Cape | 46 16 33 | 124 02 13 | ..... |
| Cape Shoalwater Light-House, 4 F W Var by Fl 14 | N point of entrance to Shoalwater Bay, 87 feet | 46 44 11 | 124 02 24 | ..... |
| Tatoosh Island Light-House, 1 F W 20 | Off Cape Flattery, Strait of Juan de Fuca | 48 23 15 | 124 43 48 | 22 02 |
| Cape Beale Light-House, W Rv every 30 secs 19 | SE point of entrance to Barclay Sound, 164 feet | 48 47 30 | 125 12 50 | ..... |
| Ediz Hook Light-House, 5 F W 10 | On False Dungeness, extremity of spit | 48 08 25 | 123 24 07 | ..... |
| New Dungeness Light-House, 3 F W 16½, 16 | On the end of the Sand Point, Strait of Juan de Fuca | 48 10 59 | 123 06 31 | ..... |
| Smith's Island L. H., 4 Rv W Var Fl every ½ m 15 | SW point of the island | 48 19 11 | 122 50 36 | ..... |
| Admiralty Head Light-House, 4 F W 16 | E side of entrance to Admiralty Inlet, 119 feet | 48 09 22 | 122 40 34 | ..... |
| Race Rocks Light-House, 2 W Fl every 10 secs | Southernmost point Vancouver, St. J. de Fuca, 118ft. | 48 17 59 | 123 31 23 | ..... |
| Fisgard Island Light-House, 4 F W G R 15 | W side ent. Esquimault Bar, Strait Juan de Fuca, 70ft | 48 25 54 | 123 26 35 | ..... |
| Atkinson Point Light-House, W Rv every M | N point of entrance to Burrard Inlet | ..... | ..... | ..... |

NOTE.—The numerals first given after each Light House indicate the order of the lights; F signifies fixed; Fl, flashing; Var., varied; Rv., revolving; Pr., prolonged; W., white; Rd., red; M., minutes, and the concluding numerals denote the distance at which the light may be seen, under ordinary states of the atmosphere, from a height of twenty feet above the sea.

## FOG SIGNALS ON THE COASTS OF CALIFORNIA, OREGON, AND WASHINGTON TERRITORY.

**Point Conception.**—A steam whistle with blasts of 8 seconds, at intervals of 52 seconds.

**Point Ano Nuevo.**—A steam whistle giving blasts of 15 seconds, with intervals of 45 seconds.

**Pigeon Point.**—A steam whistle giving blasts of 4 seconds duration, with alternate intervals of 7 and 45 seconds.

**Point Montara.**—A steam whistle giving blasts of 5 seconds, with an inverval of 25 seconds; then a blast of 10 seconds, followed by an interval of 20 seconds.

**Point Lobos.**—A fog trumpet erected by the Pacific Mail S. S. Co.; it is sounded during foggy weather, and may be heard seaward (dependent on the direction and strength of the wind) within the range of from six to ten miles.

**Point Bonita.**—A steam whistle (styled a Siren, from its peculiar sound) is placed on the extremity of the point; the trumpet gives blasts of 4 seconds, at intervals of 35 seconds.

**Fort Point.**—A bell struck by machinery every 10 seconds.

**Alcatraz Island.**—A bell, struck 4 blows at intervals of 9 seconds, followed by a pause of 28 seconds.

**Yerba Buena Island, San Francisco Bay.**—Fog bell, struck at intervals of 10 seconds. In addition there is a steam whistle giving blasts of 4 seconds, with intervals of 16 seconds.

**East Brother Island, San Francisco Bay.**—Steam whistle, blasts of 8 and 4 seconds, with intervals of 24 seconds.

**Mare Island, San Francisco Bay.**—A bell, struck at intervals of every 10 seconds.

**Point Reyes.**—A steam whistle is placed at this point, giving blasts of 8 seconds, at intervals of 52 seconds.

**Point Arena.**—A steam whistle, giving blasts of 5 seconds, with intervals of 25 seconds.

**Humboldt Bay.**—On the north side of the entrance and three-fourths of a mile from the inlet, a first-class steam whistle, giving blasts of 4 and 8 seconds, with intervals of 24 seconds.

**Humboldt Bar.**—Bell-boat anchored in 16 fathoms water. Humboldt light bears E. ¼ N. 2 miles; Red Bluff bears SE. by E. ¾E.

**Point Adams, Mouth of Columbia River.**—A steam whistle giving a blast of 7 seconds, with an interval of 14 seconds; then a blast of 4 seconds, followed by an interval of 35 seconds.

**Cape Disappointment.**—A bell, struck every 10 seconds.

**Tatoosh Island.**—A steam whistle is placed at the light-house, giving blasts of 8 seconds, at intervals of 52 seconds.

**New Dungeness.**—A steam whistle, giving blasts of 6 and 3 seconds, at alternate intervals of 12 and 39 seconds.

## Table of Distances on West Coast of North America.

### UP THE COAST.

**From San Francisco—**

| | Miles. | | Miles. |
|---|---|---|---|
| To Ballenas Bay..... | 14 | To Tillamook Head.... | 533 |
| Point Reyes..... | 30 | Cape Disappointment | 552 |
| Point Tomales..... | 46 | Shoalwater Bay..... | 578 |
| Bodega Head..... | 50 | Grey's Harbor..... | 590 |
| Fort Ross..... | 65 | Point Grenville..... | 614 |
| Point Arena..... | 101 | Cape Flattery..... | 682 |
| Mendocino City.. .. | 122 | Port Angeles..... | 738 |
| Shelter Cove..... | 166 | Port Townsend..... | 770 |
| Cape Mendocino.... | 194 | Seattle..... | 808 |
| Humboldt Bay..... | 218 | Steilacoom..... | 838 |
| Trinidad..... | 235 | Olympia..... | 863 |
| Crescent City..... | 277 | Victoria..... | 748 |
| Rogue's River..... | 319 | San Juan Island..... | 755 |
| Port Orford..... | 338 | Bellingham Bay..... | 790 |
| Cape Blanco..... | 345 | New Westminster... | 820 |
| Cape Gregory..... | 376 | Barclay Sound..... | 724 |
| Umpqua River..... | 399 | Nootka Sound..... | 784 |
| Cape Perpetua..... | 434 | Cordovo Bay..... | 1178 |
| Cape Foulweather... | 460 | Coronation Island... | 1273 |
| Cape Lookout..... | 496 | Sitka..... | 1333 |
| False Tillamook..... | 520 | | |

### DOWN THE COAST.

**From San Francisco—**

| | Miles. | | Miles. |
|---|---|---|---|
| To Pillar Point..... | 26 | To Point Vincent..... | 365 |
| Point Ano Nuevo... | 50 | Point Loma..... | 443 |
| Santa Cruz..... | 72 | Port San Quentin... | 555 |
| Point Piños..... | 90 | Cerros Island..... | 700 |
| Point Sur..... | 110 | Magdalena Bay..... | 983 |
| Point Gorda..... | 142 | Cape St. Lucas..... | 1143 |
| Piedras Blancas..... | 160 | Cape Corrientes..... | 1413 |
| San Simeon..... | 165 | Mazatlan..... | 1336 |
| Point San Luis.... | 200 | Guaymas..... | 1488 |
| Point Sal..... | 215 | Manzanillo..... | 1518 |
| Point Arguello..... | 235 | Acapulco..... | 1820 |
| Point Conception... | 253 | Realejo..... | 2590 |
| Santa Barbara..... | 293 | Nicaragua ..... | 2678 |
| Anacapa Island..... | 312 | Coiba Island..... | 3018 |
| Santa Catalina..... | 350 | Panama..... | 3260 |

## PHASES OF THE MOON, 1877.

*(San Francisco Mean Time.)*

### JANUARY.

| | D. | H. | M. | |
|---|---|---|---|---|
| Last Quarter | 6 | 6 | 7 | morn |
| New Moon | 14 | 5 | 18 | morn |
| First Quarter | 22 | 7 | 43 | morn |
| Full Moon | 29 | 0 | 29 | morn |
| Apogee | 14 | 7 | | even |
| Perigee | 28 | 6 | | even |

### FEBRUARY.

| | | | | |
|---|---|---|---|---|
| Last Quarter | 4 | 8 | 50 | even |
| New Moon | 13 | 0 | 49 | morn |
| First Quarter | 20 | 8 | 6 | even |
| Full Moon | 27 | 11 | 4 | morn |
| Apogee | 10 | 8 | | even |
| Perigee | 26 | 5 | | morn |

### MARCH.

| | | | | |
|---|---|---|---|---|
| Last Quarter | 6 | 1 | 51 | even |
| New Moon | 14 | 6 | 44 | even |
| First Quarter | 22 | 4 | 59 | morn |
| Full Moon | 28 | 9 | 39 | even |
| Apogee | 10 | 10 | | morn |
| Perigee | 26 | 9 | | morn |

### APRIL.

| | | | | |
|---|---|---|---|---|
| Last Quarter | 5 | 8 | 20 | morn |
| New Moon | 13 | 9 | 40 | morn |
| First Quarter | 20 | 11 | 27 | morn |
| Full Moon | 27 | 8 | 26 | morn |
| Apogee | 7 | 4 | | morn |
| Perigee | 22 | 8 | | morn |

### MAY.

| | | | | |
|---|---|---|---|---|
| Last Quarter | 5 | 3 | 9 | morn |
| New Moon | 12 | 9 | 19 | even |
| First Quarter | 19 | 4 | 46 | even |
| Full Moon | 26 | 7 | 55 | even |
| Apogee | 4 | 12 | | even |
| Perigee | 17 | 9 | | morn |

### JUNE.

| | | | | |
|---|---|---|---|---|
| Last Quarter | 3 | 9 | 1 | even |
| New Moon | 11 | 6 | 22 | morn |
| First Quarter | 17 | 10 | 14 | even |
| Full Moon | 25 | 8 | 43 | morn |
| Apogee | 1 | 6 | | even |
| Perigee | 13 | 4 | | even |
| Apogee | 29 | 10 | | morn |

### JULY.

| | D. | H. | M. | |
|---|---|---|---|---|
| Last Quarter | 3 | 0 | 52 | even |
| New Moon | 10 | 1 | 56 | even |
| First Quarter | 17 | 5 | 3 | morn |
| Full Moon | 24 | 11 | 9 | even |
| Perigee | 11 | 6 | | even |
| Apogee | 26 | 9 | | even |

### AUGUST.

| | | | | |
|---|---|---|---|---|
| Last Quarter | 2 | 2 | 11 | morn |
| New Moon | 8 | 9 | 7 | even |
| First Quarter | 15 | 2 | 18 | even |
| Full Moon | 23 | 3 | 0 | even |
| Last Quarter | 31 | 1 | 5 | even |
| Perigee | 9 | 3 | | morn |
| Apogee | 22 | 11 | | even |

### SEPTEMBER.

| | | | | |
|---|---|---|---|---|
| New Moon | 7 | 4 | 50 | morn |
| First Quarter | 14 | 2 | 58 | morn |
| Full Moon | 22 | 5 | 25 | morn |
| Last Quarter | 29 | 10 | 11 | even |
| Perigee | 6 | 1 | | even |
| Apogee | 19 | 5 | | morn |

### OCTOBER.

| | | | | |
|---|---|---|---|---|
| New Moon | 6 | 1 | 48 | even |
| First Quarter | 14 | 7 | 32 | even |
| Full Moon | 21 | 11 | 21 | even |
| Last Quarter | 29 | 6 | 12 | morn |
| Perigee | 4 | 9 | | even |
| Apogee | 16 | 7 | | even |

### NOVEMBER.

| | | | | |
|---|---|---|---|---|
| New Moon | 5 | 0 | 38 | morn |
| First Quarter | 12 | 3 | 34 | even |
| Full Moon | 20 | 2 | 9 | even |
| Last Quarter | 27 | 1 | 56 | even |
| Perigee | 1 | 6 | | even |
| Apogee, | 13 | 2 | | even |
| Perigee | 27 | 10 | | morn |

### DECEMBER.

| | | | | |
|---|---|---|---|---|
| New Moon | 4 | 1 | 54 | even |
| First Quarter | 12 | 1 | 24 | even |
| Full Moon | 20 | 3 | 41 | morn |
| Last Quarter | 26 | 10 | 10 | even |
| Apogee | 11 | 0 | | even |
| Perigee | 23 | 6 | | morn |

## NOTICE OF ROCKS, SHOALS, AND DANGERS,

ADJACENT TO WEST COAST UNITED STATES.

**Noonday Rock**, (off entrance to San Francisco Bay).—This danger has been removed, and its former site has 34 feet at mean low water; but Lieutenant Weeden, U. S. Engineers, has discovered two pinnacles very close to it, over one of which there is but fourteen feet at mean low water, and with deep water between them. The former position of Noonday Rock will be marked by an immense buoy, in October, 1875. As it is quite possible that an irregular ridge may connect these peaks of rock with the North Farallon, large vessels are warned not to attempt to pass between them until a more thorough survey has been made.

The following magnetic bearings (determined by A. F. Rodgers, U. S. C. S.) show the former position of Noonday Rock:

Point Reyes, western head bears N. by E. ¼ E., distant 13 8-10 miles.

North Farallon, bears E. by S., distant 3 1-10 miles.

South Farallon light-house, bears E. by S. ¾ S., distant 9 7-10 miles.

Point Boneta light-house, bears E. by N. ⅝ N., distant 30 3-10 miles.

Geographical position: latitude, 37° 47½ N.; longitude, 123° 09 W.

In the "Pilot" it is advised that vessels approaching the Golden Gate at night, or in thick weather, should keep to the southward of the South Farallon light. With Point Reyes and the Farallones in sight, vessels bound in, and running between them, should keep the western head of Los Reyes open on a NNE. course, coming nothing to the eastward until the North and South Farallones are in range, then bear away for the Golden Gate. In that position the rock will bear SE., distant two and one-third miles. Coming from the north-westward at night, vessels should not bring the South Farallon light to bear anything east of SE. by E., which will clear the rock by two miles, and the North Farallones by one mile.

**A Rock** between the South and Middle Farallon (off San Francisco Harbor) supposed to have between three and four fathoms water on it, has been seen by pilots when it breaks.

**Sunken Rock off Middle Farallon.**—This danger has 5¼ fathoms of water upon it at low water, with deep water from eight to fifteen fathoms close around it; but with a large sea on, a break has been seen upon it by pilots and the light-house keeper.

It lies S. 25° W. by compass, distant three-eighths of a mile from the Middle Farallon; and N. 72° W., distant 2¼ miles from the South Farallon light-house.

The water between this rock and the Middle Farallon reaches 18 fathoms, and from 15 to 20 fathoms between it and the South Farallon.

Located in July, 1874, by Assistant Gershom Bradford, U. S. C. S.

**Shoal near South Farallon.**—A shoal or patch has been discovered (September, 1875) by Lieut. Com. H. C. Taylor, Assistant U. S. C. S., S. 50 deg. E. and distant one-half mile (both approximate) from the South Farallon light, with six and one-half fathoms upon it, sloping down from that to sixteen and eighteen fathoms on the outside, and to thirteen and fifteen fathoms on the inside.

**Bursley Shoal**, reported by Capt. Bursley, of the ship Vitula, in 1863, as being 80 miles SSW. (magnetic) from the South Farallon Island, and having from five to seven fathoms of water on it.

Note, Ed.—The above shoal has been diligently searched for by several surveying vessels, but without success.

### Newly Discovered Shoal-spots on San Francisco Bar.

In the recent detailed survey made by Assistant Gershom Bradford, of the U. S. Coast Survey, several shoal-spots have been discovered on the Bar off the Golden Gate.

I. A spot with 4½ fathoms, bears from Point Boneta light-house S. 5½° W., distant six miles, and from Seal Rock S. 27° W., distant 4 3-10 miles, and 3½ miles broad off shore; a neighboring lump with 4½ fathoms bears W. ½ N., distant 443 yards from the former.

II. A spot having 4½ fathoms, bears from Point Boneta light-house S. 20° W., distant six miles, and from Seal Rock S. 43° W., distant 4 9-10 miles; a neighboring lump bears NW. 545 yards from the former.

III. The centre of a narrow ridge about 50 yards wide, having spots less than five fathoms, bears from Point Boneta light-house S. 37° W., distant 5 7-10 miles, and from Seal Rock S. 60° W., distant, 5 1-10 miles. Its northern limit is about half a mile southward of the range of Alcatraz and Fort Point lights; and thence stretches 600 yards to the southward and eastward.

IV. A five-fathom spot off the western tail of the four-fathom bank, bears from Point Boneta light-house S. 55° W., distant five miles, and from Seal Rock S. 82° W., distant 5½ miles.

The deepest water directly over the bar is when Alcatraz Island is open a little more than its width from Fort Point, when scant six fathoms may be carried; and the bar is narrowest at this point.

The best water that can be carried into San Francisco Bay is through

the Boneta Channel, where a depth of 8¼ fathoms is found, as in the old survey.

The bearings are magnetic; depths, at the mean of the lowest low waters; distances in nautical miles.

**Wreck of ship Flying Dragon in San Francisco Bay.**—In February, 1863, Aug. F. Rodgers, Assistant United States Coast Survey, reported the following bearings of the wreck of ship "Flying Dragon," and directions for avoiding it:

Arch or Bird Rock, E. (magnetic) distant 270 yards.

Shag Rock, N. by E. quarter N. (magnetic) distant 660 yards.

In sweeping for the "Flying Dragon," one of her spars was caught and held to with six fathoms of line out. It is not improbable that her topmast-heads come nearer the surface, and deep ships had better give the locality a good berth in working across the channel. There are twenty fathoms of water immediately around the wreck, with fourteen to seventeen fathoms half a ship's length distant on all sides. The intersection of the following ranges will show the position of the wreck: South side of Arch Rock in one with south beach of Yerba Buena Island, crossed by Saucelito Point Beach in one with Table Mountain Peak. Keeping the above ranges well open or closed, clears the wreck.

**Shoal-spot in San Francisco Bay.**—Located by Assistant Gershom Bradford, U. S. C. S.

The ridge stretches in an irregular curved line from the north-west point of Alcatraz Island to the eastern end of the Presidio Shoal, and has an average width of 700 yards within the seven-fathom line.

The depth of water upon it is not regular, and the shoalest spot yet discovered has but four fathoms of water, over gravelly bottom, at the mean of the lowest low tides; but at the lowest spring tides there will be only 22 feet upon it.

This spot lies in the regular track of vessels and is a danger to those of large draught. It is about 100 yards long, and the water around it deepens gradually to six fathoms S. by W. and N. by E. It lies S. 59° E. (SE. by E. ¼ E.) by compass, distant 790 yards, from Bird Rock; and S. 62° W. (SW. by W. ½ W.) by compass, distant 1260 yards from Alcatraz light. The following ranges also locate it: Shag Rock one with the eastern tangent of Peninsula Point; and Boneta light over the first small rise back of the brow of Mount Diablo.

The range Boneta light and the extremity of Mount Diablo passes one-fifth of a mile south of the shoal-spot.

**Rock in Mission Bay, San Francisco Harbor.**—A double-headed rock of very small extent, each head not more than three feet across, and the heads about ten feet apart. There is a depth of 12½ feet upon them at mean low water, with five fathoms over muddy bottom close around them. From the outer rock, the north corner of Merrimac-street Wharf, off Long Bridge, bears N. 80° W. (magnetic) distant 215 yards. The ranges for it are: Lone Mountain open three breadths of the tall chimney of the San Francisco Assay and Refining Works (the tallest in the neighborhood) to the south, and the top of the eastern head of Mission Rock on with the clump of bushes on the eastern slopes of Yerba Buena Island.

NOTE.—This rock is buoyed.

**Howell Rock, San Luis Obispo Harbor.**—SE. by S. ¼ S. (magnetic), one mile distant from the end of People's Wharf. Has 14½ feet on it at mean low water. Reported by Capt. Howell, steamer "Los Angeles," June, 1875.

## Dangerous Shoal in the Northern Approach to San Miguel Passage.

Lieut. Com. H. C. Taylor, U. S. N., Assistant Coast Survey, commanding steamer Hassler, reports under date of August 22d, 1875, the discovery of a dangerous shoal which lies to the northward of the NW. point of Santa Rosa Island, and about one mile from shore, with a least depth of eleven feet upon it; the bottom being rocky, with occasional specimens of red and of white coral. There is no kelp on this shoal, and no breaker except in very heavy weather.

The depths in the vicinity range from seven to ten fathoms on all sides, with a rugged and irregular bottom.

The following bearings and distances fix the position of the centre of the shoal: Northernmost point of San Miguel Island (known as Harris' Point), W. by N. 8¼ miles. Outermost rock off NW. point of Santa Rosa Island (known as Finder), S. by W. ½ W. 1½ miles. The most prominent point in the north face of Santa Rosa Island (Brockway Point), ENE. ⅝ E. 5¼ miles. Eastern end of San Miguel Island (known as Cardwell Point), WSW. ¼ W. 4¼ miles.

All vessels attempting the San Miguel Passage are cautioned not to allow the outer rock off the north-west point of Santa Rosa to bear anything to the southward or westward of S. by E., and sailing vessels are specially recommended to avoid this passage altogether, as the light airs and calms under the lee of San Miguel Island, and the strong currents

in the vicinity, combine frequently to drive a vessel upon this dangerous spot.

Other dangers, not yet developed, are believed to exist to the eastward of this.

To the northward of the shoal and three-fourths of a mile distant a band of kelp extends one-fourth of a mile in an easterly and westerly direction, with twelve and fifteen fathoms of water in and around it, and may serve as a warning when thick weather obscures the shore-line in the vicinity.

**Cortes Shoal.**—This shoal stretches about seventeen miles from latitude 32° 24 N., longitude 118° 59½ W., to latitude 32° 32 N., longitude 119° 17½ W., but curves slightly to the south-west; within the fifty fathom curve, the general trend is parallel with the islands of Santa Catalina, San Clemente, and San Nicolas. It has an average and nearly uniform width of three and a half miles. The nature of the bottom is hard, composed of white sand, broken shells, and fine coral at the south-east portion, and sand with broken shells at the north-west. The shoalest and most dangerous part is that known as the Bishop Rock, lying five miles from the south-east tail of the bank, and having but two and a half fathoms of water upon it. Around this danger the depth increases gradually, and in an extent of two and a half miles in the general direction of the bank reaches but fifteen fathoms. The position of these rocks is (approximately) latitude 35° 25¾ N., longitude 119° 05 W. From the north-west end of the island of San Nicolas the rock bears SE. ½ S., distant fifty-seven miles; and from the south-east end of the island of San Clemente it bears SW. ¼ S., distant forty-six miles. From the Bishop Rock to the west end of San Miguel Island the course is NW. ¼ W., and distant one hundred and fifteen miles.

**New Hope Rock.**—A pinnacle rock ten or twelve feet under water, breaking in a moderate westerly swell; bears due north-west (magnetic) from Point Loma light-house; it is one-half a mile from shore, and inside the line of the kelp. Reported by Capt. P. W. Packard, Pilot of San Diego Harbor.

**San Geronimo Island.**—The position of this island, as determined by the U. S. C. S., is latitude 29° 47′ 13″ N.; longitude 115° 47′ 52″ W.

**Sacramento Reef.**—This danger lies SE. ½ S. (magnetic) from San Geronimo Island, distant 6 miles; it is entirely surrounded with kelp.

**San Martin's Island.**—The position of this island, as determined by the U. S. C. S., is latitude 30° 28′ 52″ N.; longitude 116° 06′ 37″ W.

**Ben's Rock.**—This danger lies due south (magnetic), distant 3 miles, from San Martin's Island; it is about 500 yards in diameter, varying in depth from 1½ to 10 fathoms.

### The Cordell Bank, off Point Reyes, Cal.

The following information is published by authority of Professor Benjamin Pierce, Superintendent U. S. Coast Survey:

The middle of this bank lies 20 miles W. 20° S. (compass) from Point Reyes light, and 28 miles N. 64° W. from the South Farallon light, which shows just above the horizon. Table Mt. Peak is open one-quarter point south of Point Reyes.

Within the 50 fathom curve the bank is eight miles long NNW. and SSE., with an average width of 2¼ miles. There is a depth of 25 fathoms in several places upon it, but a minute examination may develop less. Within the 30 fathom line the bottom is rocky and marked by live barnacles, and reddish tubular forms with red slime inside; between 30 and 40 fathoms finely broken white shells were found; and beyond 40 fathoms the bottom is composed of coarse black sand, with gravel and broken shells. Seals, sea-lions, marine birds, and schools of whales were found over the bank.

To the westward the depth increases very rapidly, reaching 270 fathoms within 1½ miles; to the southward 275 fathoms in 4½ miles; to the northward it has not been fully developed; to the eastward the depth increases gradually to 66 fathoms in seven miles, and then decreases to Point Reyes. The currents on the banks are irregular and weak.

Should the South Farallon and Point Reyes be obscured by low fog or haze, the following compass bearings will locate it: Table Mt. Peak N. 81° E.; Ross Mt. N. 10° E.

The examinations of this bank were made by Assistant Cordell, and by F. Westdahl, aid in Assistant Bradford's party.

### Dangers off Cape Mendocino.

LOCATED BY ASSISTANT GERSHOM BRADFORD, U. S. C. S.

The bearings and distances are from the light-house.

I. The "Great Break," a rock, having 25 feet of water upon it, S. 68° W. (compass), three miles distant; from the south rock of Blunt's Reef it bears S. 5° E., distant ¾ of a mile. It breaks very seldom; 15 to 20 fathoms around it.

II. A rock having 11 feet of water upon it, S. 72° W., 2¾ miles distant; from the south rock of Blunt's Reef, it bears S. 30° E., distant ½ of a mile.

III. Heavy ground-breaks, over an area of a quarter of a mile, in 9 and 10 fathoms, S. 77° W., 2 miles distant.

IV. A rock having a quick, sharp and well-defined breaker, S. 52° W., 1⅓ miles distant. Not yet sounded upon; has 15 fathoms alongside of it.

V. A rock, having seven feet upon it, S. 25° W., one mile distant; a sharp breaker has been located just outside of it, and just inside of it the top of a rock was seen in the trough of the heavy swell. Has 12 fathoms outside of it.

VI. A ledge, several hundred yards in extent, having 12 feet upon it, S. 7° W., distant 1⅛ miles; has 12 fathoms outside it.

VII. A rock, having 13 feet of water upon it, S. 75° W., distant 1⅛ miles; it has 13 fathoms around it. One quarter of a mile inside of it there is a distinct, well-defined breaker; and three-eighths of a mile inside was seen the top of a rock in the trough of the sea.

VIII. A rock, not yet sounded upon, N. 82° W., distant one mile; it gives a sharp well-defined breaker; another rock lies about a quarter of a mile north-east of this. The first has 11 fathoms alongside of it.

IX. A rock, having 22 feet upon it, N. 66° W., distant 1⅝ miles; it has nine fathoms around it. To the southward of this rock, over an area of three-eighths of a mile, three heavy ground-breaks were seen in 8½ to 10 fathoms of water.

X. A rock, having 12 feet of water upon it, W. ½ S., distant six-tenths of a mile from the Cape Rock, lying off Cape Fortunas; it has 13 fathoms around it.

These dangers show that the passage between Blunt's Reef and Cape Mendocino should be avoided; sunken rocks extend nearly a mile off the coast, from Shelter Cove to Cape Mendocino, and vessels should not approach it too closely.

The South Rock of Blunt's Reef bears S. 82° W., distant 2 9-10 miles from the light-house. GEO. DAVIDSON, *Asst. U. S. Coast Survey.*

*February* 17*th*, 1873.

**Sunken Rock off Cape Mendocino, Cal.**—Inside of Blunt's Reef is a sunken rock with six feet on it at mean low water; no kelp about it, and its summit is only from two to three feet in diameter; soundings around it deepening rapidly to nine and fifteen fathoms on all sides. Lies one and seven-tenths miles SW. ¾ W. (magnetic) from the light-house on Cape Mendocino. The ranges are: The centre of the south-

ern slope of Sugar-loaf Rock (half-way between summit and base) on with the light-house, and the point of land at Centreville showing half-way between a small rock inside of False Cape Rock and the point of land at False Cape, which latter is on with the outer edge of woods on the point of land at Centreville. Navigation between Blunt's Reef and Cape Mendocino is extremely hazardous; vessels bound around the Cape should pass two miles to the westward of Blunt's Reef.

Located by Capt. Bradford, U. S. C. S., May, 1875.

**Cape Fortuna** (False Mendocino).—Off this cape, there is a rock with 12 feet of water, bearing W. ½ S. from the Cape Rock, and distant six-tenths of a mile.

**Chase Ledge.**—A rocky ledge, several hundred yards in extent, not well marked by kelp, and has four fathoms water upon it at mean low water, with a depth of from 13 to 15 fathoms around it. It lies about 1⅓ miles off shore, directly in the course of steamers to and from the southward of Crescent City, and in heavy south-east weather must break. The following magnetic bearings and distances are given to locate it: From Crescent City light it bears S. 40° E., 1 7-10 miles. From Round Rock (45 feet high) S. 25° E., between 8 and 9-10 of a mile. From Mussel Rock (7 feet high) S., 17° W. 7-10 of a mile. Named from A. W. Chase, Sub-Assistant U. S. C. S., who discovered it.

**Fauntleroy Rock, Harbor of Crescent City.**—A day beacon has been erected on this rock; it consists of a wrought iron spindle painted red, and sunk into the rock, surmounted by a round iron cage painted red. Height above the rock, 25 feet.

Pass in on either side of Round Rock, giving it a berth of about 100 yards; steer toward Fauntleroy Rock, and pass pretty close to it, then haul up and anchor, with Flat Rock on line with Battery Point. Kelp almost always marks the dangerous places. There is a sharp pinnacle rock 200 yards to the eastward of Fauntleroy Rock, with only two feet of water upon it, and from four to five fathoms around it.

**Sunken Rock off the Coast, south of Crescent City.**—This danger lies nearly one mile off the point near Wilson's Creek, 9¾ miles southward of Crescent City light.

The top is circular and about four feet in diameter, with only three feet upon it at low water, and within two boats' lengths around it the depth is 15½ fathoms. The sea rarely breaks upon it, and it can not be otherwise distinguished at a ship's length. There is no kelp to

mark it. From it we have the following compass bearings and distances:

Sister Rocks, NW. by N., four miles.

Far Island, E. by N., ½ mile.

The Sister Rocks lay half a mile off the coast, about 5¾ miles southward of Crescent City light.

### Dangers on the Coast between Shelter Cove and Cape Mendocino, Cal.

Sunken rocks extending in some cases nearly one mile off shore, and occupying the greater part of the passage between Blunt's Reef and Cape Mendocino, were discovered by Assistants George Davidson and Aug. F. Rodgers, U. S. C. S. Upon some of these rocks the sea breaks only occasionally with a heavy swell on at low water, and can rarely be detected when strong winds are blowing. Their positions are not yet all accurately determined; but a vessel can not safely approach the above line of coast within less than a mile and a half, or Blunt's Reef within a mile.

**Sunken Rocks in Chetko Anchorage, Oregon.**—A sunken rock, 12 feet long by 6 feet wide on top, and having 15 feet of water upon it at low water, has been discovered and located by Lieut. Comdr. H. C. Taylor, U. S. N., in command of the U. S. C. S. steamer "Hassler." Close around it the depth is five fathoms. Thin kelp grows upon it, but not sufficiently dense to be readily noticed.

It lies S. by E. ½ E. by compass, distant 700 yards from the large white house on the west point of the mouth of Chetko River. Vessels seeking anchorage here should keep the house always northerly of a N. by W. bearing, and anchor in 6½ fathoms sandy bottom, with the inner or northern rock above water bearing N., distant 370 yards, and the south-west rock bearing NW. by N., distant 230 yards. In this position the white house is open to the west of the inner or north rock, and the sunken rock described bears NE. by N., distant 175 yards. The two other sunken rocks, upon which the sea breaks, and hitherto known, lie respectively S. 30° E. distant three-quarters of a mile, and S. 30° E., ½ mile, from the white house.

**Mack's Shelter, Oregon,** is in latitude 42 deg. 14 min. 30 sec. N.; longitude 124 deg. 24 min. 30 sec. W., fourteen miles to the northward of Chetko Cove, and is distinguishable upon almost any approach, by Mack's Reef, lying off Mack's Point. This reef consists of a line of

rocks, the most prominent of which range from 100 to over 200 feet in height; the highest, called Mack's Arch, being at the southern extremity, and unmistakable from the large opening through it.

The course in for the anchorage, with Mack's Arch on any bearing from NW. by N. to E. ¾ N., leads to 350 yards distance from the Arch, carrying not less than fifteen fathoms of water, when it changes to pass to the eastward, not nearer than fifty yards, and then leads along the line of the reef in the direction of the inner or northern end, where it appears to join the shore.

With Mack's Arch bearing S. by E. ¼ E., and Mack's Point NNE. ½ E., a good anchorage is had, from 300 to 400 yards of the reef, in six and a half fathoms of water, sandy bottom. Inside of this is an inner anchorage, separated from the outer by a thick belt of kelp, stretching from the beach to the reef, but through which there is a clear channel.

With the highest point of Mack's Arch bearing S. ¾ E., the course for entering is N, ¾ W., leading through the channel in from three and a half to four fathoms water, and avoiding a *sunken rock*, with only two feet on it at low water, which lies at the edge of the kelp on the eastern side. From the northern or inner end of the channel, the course leads to the westward, and good anchorage is had just inside the kelp, in from four to five fathoms of water, sandy bottom—Mack's Point bearing E. ¾ N., and Mack's Arch S. by E. ½ E.

There are passages between the rocks, leading in to the inner and outer anchorages, apparently free from danger; but it is recommended that they should not be used until they are closely surveyed.

Wood and water can be obtained here, but no other supplies.

**Sunken Rocks on Patridge Bank, Fuca Strait.**—Reported by James S. Lawson, U. S. C. S. Within the ten-fathom curve the bank is three miles long, and ENE. 1½ mile wide, and the eastern extremity reaches within two miles of Point Patridge. The north and east sides fall off sharply to twenty fathoms. A considerable part of the bank is covered with kelp, which is much under-run by strong currents. The kelp generally extends to the seven fathom curve, except toward the eastern end, where none exists beyond a depth of four fathoms. The currents over the bank are irregular, except under the eastern extremity, where they set strongly from the north and north-west at flood and ebb tides. The bottom is generally sand, gravel, and bowlders, except near the shoalest spot, where it is rocky and thickly covered with kelp; has a depth of only 14 feet at the lowest water, and is distant 3 4-10 miles from the nearest shore of Whidby Island. The following magnetic bearings and distances are given to locate this danger: From

Smith's Island light-house it bears SSE., distant 3 8-10 miles. From Admiralty Head light-house it bears W. by N., ¾ N., distant 8 7-10 miles. From Point Wilson it bears NW. ½ W., distant 7 3-10 miles. From New Dungeness light-house, it bears NE., distant 11 5-10 miles.

NOTE, ED.—A buoy has since been anchored in 20 feet of water, 66 yards S. 25½° E. of the 14-feet rock.

**Strait of Juan de Fuca.**—A patch of kelp is found one mile south of the south-eastern point of Bellevue or San Juan Island, and eight and a half miles NW. by W. one quarter W. from Smith's Island, with three fathoms marked on it, but it is reported that H. B. Co's steamer "Otter" found only six feet.

Bearing W. half S. from Smith's Island, and eight miles distant, is another field of kelp, nearly a mile in extent, having five fathoms throughout it.

**Rock in Roche Harbor, Haro Strait.**—SCOUT PATCH.—This dangerous rock, which narrows considerably the northern passage into Roche Harbor, lies in the centre of the channel westward of Pearl Island. It is half a cable long, with 17 feet at low-water springs, and bears from the centre of Neck Islet (which is connected by a narrow sand spit to the western end of Pearl Island) SW. ¾ W., distant one and three-fourths cables. A narrow five-fathom channel at low water exists on the eastern side of the patch.

Bearings (magnetic); Variation 22° E. in 1869.

**Unit Rock in the Canal de Haro.**—When eight and a half miles within the south entrance of the strait, the width decreases to three and a half miles, having Darcy Island on the west; off its NE. face lies a small islet, and off the SE. face lie very large fields of kelp, stretching far off to the south-east; in 1863, in one of these fields, was discovered a sharp pointed rock, called Unit Rock, lying E. by S. ⅝ S. (magnetic) from the SE. part of the island, and distant three-quarters of a mile; the sharp apex of this rock was about three feet above water at the very lowest tides.

Since this discovery, several rocks, covering a space of half a mile square, on the same bearing from the south-east point of Darcy Island, have been found. They are marked by a field of kelp, and one point uncovers at the lowest tides. Near mid-channel a depth of 155 fathoms is found.

**Lawson Reef.**—This ledge lies at the south-eastern part of the southern entrance of Rosario Strait, Washington Sound, and directly off the

western entrance to Deception Pass. Its general direction is north and south (by compass), and within the eight-fathom curve is six-tenths of a mile in length and three-tenths of a mile in breadth. The kelp patch marking it is half a mile long north and south, and lies over the part of the reef having six fathoms of water and less. The shoalest part is about 170 yards in extent, and has three and three-quarters fathoms over it at mean low water.

The depth of water increases very rapidly away from the reef, but more particularly on the north-east side, where a depth of thirty fathoms is found within two hundred yards of the ten-fathom curve. On the west side the thirty-fathom curve lies a quarter of a mile from the ten-fathom curve. Within half a mile from the ledge on the east and south sides, the depth of water is fifty fathoms.

The following compass bearings and distances locate the shoalest part, which is about the middle of the ledge. Deception Island bears N. 59° E., distant 1.75 miles. Burrows Island, just open by Allan Island, N. 22° W., distant 4.5 miles. Eastern point of Watmough Head, S. 85° W., distant 4.0 miles. Smith's Island light-house, S. 23° W., distant 7.3 miles. Point Patridge, S. 10° E., distant 10.5 miles. This reef has been named from James S. Lawson, U. S. C. S.

**Portlock Bank.** — Latitude 58° 16 N., longitude 149° 42 W. This extensive bank was located in the given position by the U. S. Coast Survey in 1867; it is about one hundred miles ENE. easterly (true) from St. Paul's, Kodiak Island. The shoalest water, found on a single line of soundings only, was forty-five fathoms in the above position; bottom, black sand, pebbles, and mud. Detailed examinations are necessary to give the limits of this bank, which is believed by soundings given by Portlock, Cook, and others, to be very extensive.

**Ounimak Bank.**—Latitude 53° 35 to 53° 40 N., longitude 164° 10 to 164° 30 W. The extent of this rich Cod Bank, lying eastward of Ounalaska Island, is not known. Soundings in fifty and sixty-five fathoms were obtained upon it by the U. S. Coast Survey in 1867, in thick weather, with approximate positions as above given, being sixty-five miles ESE. (true) from the middle of Akoutan Passage, and forty miles SSE. (true) from the Ounimak Passage; bottom, black and white sand, with pebbles.

**Suwanee Rock.**—This rock, on which the U. S. ship Suwanee was wrecked in July, 1868, lies in Shadwell Passage, about 150 feet from Hope Island. It is nearly awash at low water, and is not laid down on

the latest Admiralty charts. In entering this passage from the Goleta Channel, give a good berth to the point of Hope Island (as the rock lies a little to the northwest of a line drawn from this point to the nearest point of Vansittart Island), then round into Shadwell Passage with eight fathoms water, gradually deepening to twelve fathoms, when abreast of Lone Tree Island. Unless well acquainted with this locality, or under charge of a competent pilot, it is not recommended for ships to use this passage; Bates Passage, to the southward and eastward of Vansittart Island, is a deep, clear channel, and the distance is very little greater.

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### The Following Notices

Are arranged in the order of their latitudes, commencing at the most northern ones and proceeding south:

**Shoal** in the Bay of Anadir, latitude 64° 15 N.; longitude 178° 00 W. Is about two miles in extent, and only eight feet of water upon it.

**Island.**—Latitude 59° 26 N.; longitude 146° 05 W. Ten miles long and five miles wide; not laid down on charts. Reported by Captain Freeman, U. S. steamer Newbern.

**Rock** near Jonas Island, Sea of Okhotsk: latitude, 56° 27 N.; longitude, 143° 14 E. Is about 1½ miles N W. by N. from the island, with but six inches of water upon it; deep soundings around it.

**Barrick Rock, Gulf of Tartary.**—Latitude 45° 42 N.; longitude 140° 42 E. Twelve miles west of Rifunsiri.

**Reef** in latitude 44° 23 N.; longitude 152° 53 W.

**Island** in latitude 41° 54′ 30″ N.; longitude 133° 46′ 50″ E.

**Reed or Falmouth Rocks.**—Latitude 37° 28 N.; longitude 137° 28 W. These rocks, reported in former editions of this Almanac as separate dangers, have since been assumed to be identical, with the probable position as given above.

Note.—Extract from Maury's Sailing Directions, 8th vol. "A green strip of water is often seen by captains of packets a couple of hundred miles off the coast of California, which, on approaching the coast, they cross, again entering dark blue water before making the green water of the coast soundings. Capt. Elias Hempstead informs me that he can depend upon it as much as on the Gulf Stream in the Atlantic."

Note to above, Ed.—Capt. Gibbs, of the ship Two Brothers, informs me that the above green strip of water where he crossed it, was seventy-five miles wide; he entered upon it suddenly, and left it in the same manner.

**Shoal.**—Latitude 35° 30 N.; longitude 155° 17 E. Reported by Capt.

Warsaw, of the P. M. steamer Colorado; he found 80 fathoms on the southern edge of it.

**Elmstone Rock.**—Latitude 35° 13′ N.; longitude 139° 43′ E. In the Uraga channel, leading into Yedo Bay, with ten feet over it at low water, more than 300 feet in extent, with kelp near the surface. From the shoalest part, the east extreme of Cape Kami-saki bears N. by E. ½ E., the south extremity of the northern shore of Uraga Cove W. ½ N., and the Plymouth Rocks, S. by W. To avoid it, do not bring Cape Kami-saki eastward of N. ½ E., or the Plymouth Rocks southward of S. by W. ¾ W.

**Rock in the Straits of Simonosaki, Niphon.**—Latitude 34° 28′ N.; longitude 131° 0′ 51″ E. Is sixty fathoms long, north-west and south-east, with four feet of water over it on the southern, and two fathoms on its northern extremity, with five fathoms between both extremities at low spring tides, and deep water close to. From the rock Moze-saki bears S. 62° W., Isaki S. 68° E., Kusi-saki N. 35° E., and the south point of Manziu N. 61° E. It is a late discovery.

**Powhatan Reef.**—Latitude 30° 42′ N.; longitude 130° 20′ E. Reef of rocks about one mile in extent. From the centre rock the south-west point of Volcano Island bears NW., the east point of the same N. ½ W., and the east point of Fakesima, or Apollos, NE. ½ N.

**Mariners' Hope Reef.**—Latitude 30 deg. 25 min. N.; longitude 122 deg. 5 min. E. The Mariners' Hope struck on a reef between Fisherman's Group and Chusan Islands, which was found to be one-third of a mile long, east and west, and two cables' length broad. From the ship, which had seven fathoms under her bow and only five feet astern, the southern extremity of Chinsan bore E. ¾ S., large volcano SW., westerly, the Rugged Islands from NNW. ¼ W. to NNE. ½ E., and Skead Island S. ¾ E., distant three miles. Subsequently the Hamburg bark Emerald was lost on a rock about three miles S. ½ E. from Skead Island, confirming the above.

**Arabia Shoal.**—Latitude 29 deg. 30 min. N.; longitude 155 deg. 55 min. W., extending SSE. and NNW. two miles, by one mile in breadth, the lead giving eleven fathoms.

**Island.**—Latitude 28 deg. 35 min. N.; longitude 171 deg. 42 min. W.

**Middlebrook Island and Reef.**—Latitude 28 deg. 16 min. N.; longitude 177 deg. 12 min. W.

**Reef on the Coast of Lower California.**—Latitude 27 deg. 52 min. N.; longitude 115 deg. 05 min. W. The Emerald touched on a reef between Natividad Island and Point Eugenie, one mile to the eastward of Seal Rock.

**Shoal.**—Latitude 27 deg. 40 min. N.; longitude 140 deg. 49 min. W.

**Bank.**—Latitude 25 deg. 43 min. N. to 26 deg. 3 min. N.; longitude

173 deg. 30 min. W. The brig Delaware reports a bank extending north-west and south-east about thirty miles, apparently very shoal. The U. S. Surveying schooner Fenimore Cooper found bottom, at from fifteen to forty fathoms, between the parallels 25 deg. 43 min. N. and 26 deg. 3 min. N. and the meridians of 173 deg. 29 min. W., and 173 deg. 32 min. W.; both reports confirm the existence of this bank.

**Passion Island.**—Latitude 25 deg. 48 min. N.; longitude 136 deg. 36 min. W. Whalers' report.

**Boxer Rock, Amoy Harbor.**—Latitude 24 deg. 28 min. 5 sec. N.; longitude 118 deg. 2 min. 36 sec. E. In the fairway of the western entrance into Amoy Harbor, with twelve feet of water on it. From it Hanson Island bears N. 39 deg. W.; Kulangusan Island, north-west point, S. 21 deg. W., north point, S. 11 deg. E.; Dock Island S. 78 deg. E., and nearly in line with the church.

**Roebur Rocks.**—Latitude 24 deg. 09 min. N.; longitude 122 deg. 23 min. E. The ship Roebur reports in this position a group of rocks sixty feet high, perpendicular on all sides, broken in two or three places, the ledge about 300 feet long. Half an hour after losing sight of them, Koumi Island was made.

**Oriental Bank.**—Latitude 23 deg. 58 min. 54 sec. N.; longitude 122 deg. 40 min. 30 sec. E. The Oriental reports passing within two cables' length of a round sand-bank of three cables' diameter, on which the sea broke violently. Her chronometer had been corrected by Agincourt Island.

**Breakers.**—Latitude 23 degrees 47 minutes 50 seconds N.; longitude 120 degrees 2 minutes 30 seconds E. Captain Richer reports a very extensive line of breakers, on which the sea broke furiously, in the middle of the passage between the Pescadores Islands and the west coast of Formosa.

**Shoal.**—Latitude 23 deg. 45 min. N.; longitude 163 deg. 30 min. W. Ship E. L. Frost reports a shoal less than 100 miles WNW. from Bird Island, with seventeen and twenty fathoms of water on it, coral bottom, and upwards of fifty miles in extent from north to south.

**Hesper Rock, Coast China.**—Latitude 23 deg. 20 min. 30 sec. N.; longitude 117 deg. 7 min. E. A rock with ten feet water on, Plat Island bearing S. 73 deg. W.; Dome Island N. 52 deg. E.; Three Chimney Bluff N. 12 deg. E.

**Thomson's Reef.**—Latitude 14 deg. 40 min. N.; longitude 122 deg. 6 min. W. Reported by Capt. Thomson, of ship Glad Tidings, as being about 40 feet long, and 8 or 10 feet high, with a sharp pinnacle in the middle; color a reddish brown plenty of birds around.

**Montafur Shoal.**—Latitude 13 deg. 7 min. N.; longitude 124 deg.

7 min. E. The ship Manly was wrecked on this shoal, which is said to be four miles from shore.

**Condor Reef.**—Latitude 10 deg. 42 min. N.; longitude 102 deg. 48 min. E. This position is assured as a mean of several reports of this danger, on which two or three vessels have been lost.

**Julia Shoal.**—Latitude 9 deg. 56 min. N.; longitude 109 deg. 9 min. E. This shoal, only lately established, is a small coral patch about a quarter of a mile in extent, with two and a half fathoms at low water, SE. by E. three and a half miles from Pulo Sapata. Pyramid Rock, in line with the right extremity of Pulo Sapata, clears it to the northeast.

**Shoal.**—Latitude 9 deg. 29 min. N.; longitude 121 deg. 20 min. E. The ship Cito struck on this shoal and was lost, four or six miles south of Cagayanoillo.

**Reef.**—Latitude 6 deg. 27 min. 30 sec. N.; longitude 162 deg. 21 min. W. This position is given as the mean of several reports of this danger, which is described as composed of coral and sand, and when the breakers on the north-east part bear east, with a moderate wind, a few spots of sand or coral can be seen above water. The northern part runs ESE. and WNW., 12 miles. Shoal water extends several miles to the southward. The steamer Tartar struck on this reef.

**Shoal.**—Latitude 3 deg. 53 min. N.; longitude 166 deg. 06 min. W.; 3¾ miles long. WNW. and ESE., ⅛ mile wide; had apparently about 6 feet water on it; no soundings taken.

**Fanning Island.**—Latitude 3 deg. 49 min. N.; longitude 159 deg. 20 min. W. This is assumed to be the correct position of this island, being a mean from eight different reports.

**Howland Island.**—Latitude 0 deg. 50 min. N., longitude 176 deg. 35 min. W. This is assumed to be the correct position, deduced from eight different reports.

**Baker Island.**—Latitude 0 deg. 15 min. N.; longitude 176 deg. 22 min. W. This is assumed to be the correct position, deduced from seven different reports.

## SOUTH PACIFIC OCEAN.

**Jarvis Island.**—Latitude 0 degrees 22 minutes 4 seconds S.; longitude 159 degrees 53 minutes W. This is assumed to be the correct position, deduced from four different reports.

**Drummond Island, with Nautilus Shoal.**—Latitude 0 deg. 30 min. S.; longitude 174 deg. 20 min. E. This island is the Nanouti or Sydenham Island of most charts. The Nautilus shoal is the coral bank with nine fathoms water over it, extending from the north-west point of the island 1½ miles beyond the reef which makes out from this point.

**Rock in Gardiner Bay, Galapagos Island.**—Latitude 1 deg. 22 min. S.; longitude 89 deg. 44 min. W. A rock has been discovered in the centre of Gardiner Bay of about thirty feet in length NW. to SE., and ten feet broad, with thirteen and a half feet water over it, and seven and a half fathoms close to. From it the outer end of the island lying in the east part of the bay bears S. 70 deg. E., two-thirds of a mile distant; a small island in the south-west part of the bay, S. 50 deg. W., one half a mile; the centre of Gardiner Island N. 61 deg. E. half a mile; and the extreme west end of the bay, W. one mile distant.

**Reef.**—Latitude 1 deg. 31 min. S.; longitude 175 deg. 35 min. W.

**Shoal in Bauca Strait.**—Latitude 2 deg. 34 min. S.; longitude 105 deg. 48 min. E. Mud-bank with four fathoms water on it, Nangka Island bearing N., and the middle of Mount Parmasang E.

**Phœnix Group.**—

| | | |
|---|---|---|
| Mary's Island..... | Lat. 2 deg. 41 min. S.; | Long. 171 deg. 40 min. W. |
| Enderbury's Island. | " 3 deg. 08 min. S.; | " 171 deg. 08 min. W. |
| Birnie's Island..... | " 3 deg. 34 min. S.; | " 171 deg. 33 min. W. |
| Phœnix Island..... | " 3 deg. 42 min. S.; | " 170 deg. 40 min. W. |
| McKean's Island... | " 3 deg. 35 min. S.; | " 174 deg. 17 min. W. |
| Sidney Island..... | " 4 deg. 30 min. S.; | " 171 deg. 30 min. W. |
| Hall's Island..... | " 4 deg. 30 min. S.; | " 172 deg. 20 min. W. |
| Gardner's Island... | " 4 deg. 37 min. S.; | " 174 deg. 40 min. W. |

**Island.** — Latitude 3 deg. 55 min. S., longitude 170 deg. 15 min. W. Reported by ship Corinthian as extending E. by S. and W. by N. fifteen miles, three miles broad, with only a small part above water.

**Starbuck Island,** west point. Latitude 5° 37′ S., longitude 155° 56′ W.

**Shoal in Sunda Strait.**—Latitude 6 degrees 38 minutes 30 seconds S.; longitude 105 degrees 23 minutes 45 seconds E. Welcome Bay, on the southern shore of Sunda Strait, appears full of dangers. A shoal, with 12 feet on it, and 6 fathoms close to, extends between Second Point and Tambiang Point to the distance of half a mile off shore.

**Garcia Rock in Malabrigo Road, Coast of Peru.**—This rock is the shoalest part of a rocky patch, about two cables in extent, consisting of pinnacles, with sand between. The least water found was twelve feet, with fourteen and eighteen on other parts of the shoal. The Garcia Rock of twelve feet is a little more than half a mile from the shore, with the extremity of Malabrigo Point SW. ½ S., Observation Point (which may be known by the black rocks off it) S. by W., and a white cross westward of the village SE. ¼ E. Vessels may anchor in Malabrigo Road in four fathoms, with the centre of the village ESE., distant about three-quarters of a mile, and avoiding the above rocky ground

by Observation Point not being brought to bear eastward of S. ¼ E. Variation in 1869, 10 deg. 22 min. East.

**Thomasset Rock.**—Latitude 10 deg. 21 min. S.; longitude 138 deg. 29 min. W. It is fifteen and a half miles E. by N. from the north-west point of Magdalena Island (the south-easternmost of the Marquesas), and is ten feet under water.

**Neptune Reef.**—Latitude 12 deg. 54 min. S.; longitude 161 deg. 45 min. W. This reef, on which the ship Neptune struck, is described as being sixteen to eighteen miles long, by about seven wide, forming a deep lagoon. The only raised portion of the reef visible from the ship's topmast-head was a rock, about six feet high, near the centre of the eastern side.

**Island.**—Latitude 13 deg. 0 min. S.; longitude 160 deg. 0 min. W.

**Shoal off Point Venus, Tahiti.**—Latitude 17 deg. 29 min. S.; longitude 149 deg. 33 min. W. Seen by the French ship St. Clair; has eighteen feet water on it. Point Venus bearing E. by S. by compass, distant four and a half miles; would be nearly two miles outside of the Dauphin Bank, the westernmost danger reported on French authority.

**Island.**—Latitude 19 deg. 24 min. S.; longitude 139 deg. 24 min. W. Reported to exist ten miles west of Egmont Island.

**Miller Reef.**—Latitude 20 deg. 51 min. S.; longitude 158 deg. 02 min. E. This reef, on which the bark Henry Miller struck in December, 1868, was found to be in the above position from observations taken on the reef, and appeared to extend about two miles in a north-west and south-east direction, and to be about one cable in width. A rise and fall of eighteen inches at neaps was observed, as also a slight set to the northwest.

**Reef.**—Latitude 21 degrees 43 minutes S.; longitude 176 degrees 42 minutes W. H. B. M. ship Pelorus sounded in this position at night and found six and a half and seven fathoms.

**Reef.**—Latitude 22 degrees 47 minutes S.; longitude 151 degrees 07 minutes W. The bark Henry is reported to have been lost on a coral reef in this position, over which there is only eleven feet of water.

**La Brilliante Shoal.**—Latitude 23 deg. 13 min. 52 sec. S.; longitude 170 deg. 4 min. E. This dangerous reef, described as a round patch of coral about one-quarter of a cable in diameter, with one or one and a half fathoms of water over it, was removed from the charts after an unsuccessful search for it in 1853, but has been since seen from the ship Creole. Two soundings in twenty and twenty-three fathoms were obtained in its vicinity.

**Rock near Bolivia.**—Latitude 23 degrees 23 minutes S.; longitude 70 degrees 42 minutes 39 seconds W. This is a new discovery, has nine feet of water over it, is one and three-quarter miles west of the Largortos Reef, south of the Mexillones Bay, the Morro de Mexillones bearing from it N. 11 degrees E. by compass, and Moreno S. 32 degrees E. From seven and a half to twelve fathoms were sounded in the channel between it and the Largortos.

**Oend Island.**—Latitude 24 degrees 1 minute 30 seconds S. (north end); longitude 130 degrees 41 minutes W. Dangerous, uncovered at low tide. The position given was determined by Captain Beechey, H. B. M. Navy.

**Rock.**—Latitude 26 degrees 0 minutes S.; longitude 106 degrees 28 minutes W., standing four feet awash. Reported by ship Minnehaha.

**Haymet Rocks.**—Latitude 27 degrees 11 minutes S.; longitude 160 degrees 13 minutes W. The cutter Will Watch passed between two rocks, about a quarter of a mile distant from each other, with apparently seven or eight feet of water over them, and struck on the northern one.

**Island off the Coast of Chili.**—Latitude 31 degrees 40 minutes S.; longitude 73 degrees 25 minutes W. Reported by ship Tubal Cain as being fifteen miles long, north and south, consisting of a white mass, one part 200 to 250 feet high, having on its northern side a peculiar peak, resembling a Spanish cap, turned to the southward.

**Houghton Reef.**—Latitude 31 degrees 40 minutes S.; longitude 154 degrees 28 minutes E. Has eight or ten feet of water over it, breaking heavily, and extending three-quarters of a mile from SE. to NW.

**Curphy Bank.**—Latitude 31 degrees 48 minutes 30 seconds S.; longitude 152 degrees 48 minutes E. The sea seldom breaks on this bank. It lies NNE. ⅓ E., distant three miles from Crawdy Head, and has five fathoms of water over its shoalest part, with thirteen fathoms inside.

**Rock, Coast Chili.**—Latitude 32 degrees 22 minutes S.; longitude 71 degrees 31 minutes W. Reported by mail steamer Bogota as a sunken rock, on which the sea breaks occasionally, lying two miles WSW. of Cruz de la Balena Point, about forty-two miles northward of Valparaiso. (Var. 16 degrees E. in 1864.)

**Mas-a-Fuera Island.**—Latitude 33 degrees 40 minutes S.; longitude 80 degrees 56 minutes 30 seconds W. Authorities have differed in regard to the exact position of this island. The one given was brought from the island in four days to Valparaiso by H. B. M. ship Talbot, and can be relied on as correct.

**Lightning Rock; Entrance to Port Philip Harbor.**—Latitude 38 degrees 17 minutes S.; longitude 144 degrees 38 minutes E. Two patches of sunken rock have been found outside of Point Nepean, in the entrance of Port Philip. They are nearly 170 feet apart, about NW. by W. and SE. by E. from each other; and a line passing through the tidal flag-staff and the Point Lonsdale red-ball beacon leads over the middle of both. The eastern patch is about 15 fathoms in extent, with only 29 feet of water over its shoalest part, and seven to eight fathoms close by. It is eight-tenths of a mile SW. by W. from the red beacon on Nepean Dry Rock, and about one and two-fifths miles SE. by E. from Point Lonsdale flag-staff. The western patch is about one-third larger than the eastern, and is the most dangerous, being nearer the fairway, and having only 16 feet water on the shoalest rock, which rises abruptly in eight fathoms. At about twenty fathoms to the southward of it there is another rock, with only twenty-four feet over it. The western patch lies about nine-tenths of a mile WSW. from the red beacon on Nepean Dry Rock, and about one and one-tenth miles from the Lonsdale flag-staff.

To avoid these dangers, vessels going in or out should endeavor to keep to the westward of both. Keep the new light-house just open to the westward of the red obelisk on Shortland Bluff until you open Point Lonsdale telegraph station well out to the northward of the tidal flag-staff when going in, and well out to the southward of the tidal flag-staff when going out. Bearings are magnetic, and depth at low water spring tides.

**Rock, in Bass Strait.**—Latitude 39 degrees 28 minutes 30 seconds S.; longitude 146 degrees 43 minutes E. The ship Clarendon struck upon a rock at half tide with apparently only ten feet of water over it; it proved to be round, and about forty or fifty feet in circumference. The highest part of Curtis Island bore W. by S. when the ship struck, and the inner Sugar Loaf S. W. by S., three miles distant.

**Duke of York's Islands.**—"On beating up along the west coast of Patagonia for the Straits of Magellan, the wind moderate, ship heading east, Duke of York's Islands in sight, and Conception Strait also traceable, an islet was observed from H. M. S. Scout, with rocks above water south of it, the ship at the time being in latitude 50 degrees 47 minutes 45 seconds S.; longitude 75 degrees 45 minutes W., and the island bearing E. ½ N., distant three and a half to four miles. The northern islet, or rock, seemed to be about ten feet high, bare, rugged, and nearly two hundred feet in length. The rocks south of it were nearly covered with broken water, but distinctly seen on a wave receding."

**Rock, in Magellan Strait.**—Latitude 50 degrees 47 minutes S.; longitude 75 degrees 20 minutes W. A rock above water with heavy breakers all around it, bearing nearly SE. from Cape St. Jago (the south-west extremity of the Duke of York's Island), distant from it four or five miles.

**Rock, in Magellan Strait.**—Latitude 50 degrees 48 minutes 30 seconds S.; longitude 74 degrees 14 W. Reported by Comdr. Shirley, U. S. S. Suwanee, as a rock in Smyth Channel, near Cape Charles and in the given position, without kelp on it, but the ripple from the paddle made the water break. Its existence is confirmed by Capt. Bradbury of the Am. Steamer Colorado, who states that it may have one foot of water over it. To avoid it, keep well on the eastern shore, after passing Cape Charles, till the Quia Channel is open.

**A Harbor of Refuge near Cape Horn.**—Latitude 55 degrees 32 minutes S.; longitude 67 degrees 35 minutes W. The Captain of the British Bark Cedric of Liverpool reports having discovered a splendid bay with safe anchorage in the Island of Wollaston, Hermit group, south of Terra del Fuego, 29 miles from Cape Horn; it is fully protected from all winds and storms, and an abundance of wood and fresh water can be obtained.

Passing outside or inside of the Island of Ildefonso, heading for False Cape Horn and passing within two miles clear of it, steer N. ¼ W. by compass, which will bring the point of the island in view; eighteen miles further on the anchorage is reached in 9 to 12 fathoms of water with a good clean bottom.

NOTE.—A large portion of the above list of dangers are extracts from the "List of reported dangers in the Pacific Ocean," issued by the Navy Department, Washington, a work which was compiled with great care and from every known authority, by the Bureau of Navigation, and is undoubtedly correct. The selections made are such as were considered most essential for navigators bound to this Port, and as many of them were entered as the limit of the Almanac would permit.

Hereafter, shipmasters will confer a favor by reporting to me such new dangers as they may discover, with their positions, as close as it may be possible to determine, and if of shoals, the depth of water shown by the lead. Verifications of doubtful dangers, heretofore reported, will be cheerfully received and entered in future editions.

THOMAS TENNENT.

## SAILING DIRECTIONS

## FOR APPROACHING AND ENTERING SAN FRANCISCO BAY.

*From the U. S. C. S. Coast Pilot*, 1869.

(The bearings given are Magnetic.)

In approaching the land in the vicinity of San Francisco, it is of great importance that accurate determinations of their vessel's position should be often obtained by ship-masters, as fogs and thick weather are apt to prevail near the land.

**Coming from the southward** it is customary to make the coast about Point Año Nuevo, (latitude 37 degrees 07 minutes north) and then to follow it up to the bar, keeping about four or five miles from the shore. If the weather be foggy or thick, vessels should keep closer to the shore, so as not to lose it, as there are no dangers between Point Año Nuevo and the bar. In good weather, pass Point Año Nuevo on a NW. by N. ¾ N. course, at about eight miles distance, and continue this course until you are abreast of Point San Pedro, five miles off; then steer N. ¼ E. for Point Boneta light-house, until you are within five-eighths of a mile of the south end of Boneta, and have Alcatraz light-house bearing NE. by E. ½ E. of you open to the southward of Boneta. Now steer for Alcatraz light-house, passing nearly half a mile to the southward of Point Boneta and one-third of a mile to the northward of Fort Point; and continue this course until the south end of Yerba Buena Island bears E. ½ N., and you are nearly one and three-quarter miles from Alcatraz. Now steer E. ½ N. for the south end of Yerba Buena, having the southern portion of the town of Oakland visible to the southward of it. This clears Blossom Rock. [Note—Ed.: This rock has been removed, and the locality has now twenty-four feet of water on it at a mean of the lowest low waters.] On this course, when you are exactly between Alcatraz light-house and North Point, steer ESE. along the line of wharves, and anchor off the north-east front of the city in ten fathoms soft mud. But sailing vessels should be careful in using the course for Alcatraz light, as otherwise they may be carried too close to the northern shore, where they are apt to be be-

calmed and baffled with variable airs and strong current eddies, and are sometimes carried ashore. Care must be taken, on the other hand, not to approach Fort Point too close, as the currents set around it irregularly and with great rapidity, and the bottom is uneven and rocky. Should the wind be so that the vessel can not obtain the range of the light-house without tacking, then she may cross the bar with Boneta light-house bearing from N. by W. to NE. by E.; give Boneta a berth of a mile, and when within the Heads, with Boneta abeam, gradually opening Alcatraz light-house north of Fort Point, until abeam of the latter, when proceed as before.

**Coming from the westward**, first sight South Farallon light-house, (latitude 37 degrees 42 minutes north) which leave to the northward, and steer NE. by E. seventeen miles, which will bring you close to the bar, and you will have Fort Point light exactly ahead of you. Now bring Alcatraz light to bear NE. by E. ½ E., when it will appear about midway between Point Boneta light and Fort Point light. Cross the bar on this course for Alcatraz, and proceed as before directed. From South Farallon light-house, Point Boneta light-house bears NE. by E., distant twenty-three and two-thirds miles.

**Coming from the northward and westward**, first make Point Reyes, which is 597 feet high, and is in latitude 38 degrees 0 minutes north, and longitude 123 degrees 0 minutes west. (A light has since been placed on this point.) Pass within two or three miles of it, but be careful not to get too close; for, although there are fifteen fathoms within a quarter of a mile of the shore, vessels are apt to lose the wind by getting under the Point. From Point Reyes steer ESE. twenty-two and a quarter miles, or until you open Alcatraz light-house to the southward of Point Boneta, when you must steer for Fort Point light-house about E. by N. ¾ N., and cross the bar on that range. On this course, when Point Boneta light-house bears NW. ½ N. a little abaft of the beam, Alcatraz light will bear NE. by E. ½ E., when you must steer for it and proceed as before directed.

## DIRECTIONS FOR VESSELS IN THICK WEATHER.

Strangers approaching the entrance in thick weather should do so with great caution, carefully taking frequent soundings with not less than two hundred fathoms of line; and as soon as soundings are had within this depth, they should stand off and on until the weather clears, or a pilot can be had. The line of one hundred and fifty fathoms is dis-

tant four miles from North Farallon, nearly five miles from South Farallon, twenty-four miles from Point San Pedro, eighteen and a half miles from Pigeon Point, and seventeen miles from Point Año Nuevo. The neglect of this important precaution has caused the loss of several valuable vessels and many lives. Steamers in thick weather are accustomed, if their captains be well acquainted with the entrance, to run close along the coast, and endeavor to make the land north of Point San Pedro, running in until they get about fifteen fathoms, and then lay a course for the bar, shoaling upon it to about five fathoms, and then gradually deepening, while the fog-whistle gives them the direction of Boneta light-house. In this way shipmasters familiar with the entrance frequently run in during dense fogs; but strangers should never attempt it.

The United States sloop of war *Vincennes*, during the cruise of the exploring expedition, anchored on the bar in a calm, and when the flood-tide made, it brought up a swell that broke over her.

**In beating out**, vessels start on the last quarter of the flood, make the first tack to the northward of the Blossom Rock (since removed), and weather it on the second; thence they keep between Alcatraz and the south shore, avoiding Bird Rock, one mile west of the south end of the island, and giving a good berth to Fort Point, past which the ebb current will carry them rapidly (with a strong tendency toward the south shore), and a couple more tacks carry them clear of the Heads. If the vessel be bound to the northward, and the weather shut in thick, with the wind to the north-west, she makes a tack off shore to the southward of the Farallones; if the weather be clear, short tacks are made off shore until she works up to Point Reyes, because the sea to the leeward of that headland is much smoother and the current less; then stand off until a course can be made for her port.

## THE WINDS.

It has been advised to work close along shore to northern ports during the summer north-west winds, and take the chances of land-breezes to make latitude; but the attempt will double the length of any voyage. Baffling light airs and calms frequently exist along the coast, while vessels several hundred miles off have strong north-west winds. Moreover, along the coast we know the current frequently sets two miles per hour from the northward, except very close under the shores. In our experience, we never yet have met a wind off the land north of San Francisco, and very rarely indeed south of it, except in the region of Santa Barbara Channel. As a general rule, it may be safely stated that the sum-

mer winds follow the line of the coast, nearly, and gradually draw towards and over the land. In winter, with wind from the southward, this is not so marked.

From April to October, inclusive, the prevailing wind is from the north-west, changing to west in valleys opening upon the coast, but in no case so strongly as through the Golden Gate.

During the summer, the wind sets in strong about ten A. M., increasing until nearly sunset, when it begins to die away. During its height it almost regularly brings in a dense fog, which, working its way over the peninsula, meets that already advanced through the Golden Gate, and envelops San Francisco and the bay by sunset. As a rule, the breeze does not dispel the fog. If a fog exists outside, the wind is sure to bring it in, but the heated earth dissipates it for a time.

From November to March, the wind is frequently from the south-east, blowing heavily, working round to the south-west, with a large and broken swell from the south-west, weather thick, rainy, and squally; the wind not unfrequently ending at north-west, with an ugly cross-sea. During heavy south-easters, the sea breaks upon the San Francisco bar, clean across the entrance, presenting a fearful sight. The sound can be heard at the anchorage in front of the city.

During some winters a hard "Norther" will spring up and blow steadily and strongly from one to five days, with a clear blue sky and cold bracing weather. Winds rarely blow from points between north, round by the east to south-east.

The further north we advance, the heavier blow the gales in winter. The north-west winds are not predicted by the barometer, but those from the south-east are, almost invariably; the mercury falling one inch from its usual height of about thirty inches. When it begins to rise the wind may be expected soon to shift round by the west, and to decrease.

## HARBOR LAWS AND REGULATIONS OF THE PORT OF SAN FRANCISCO.—May 15, 1874.

### Extracts of Pilot Laws.

All vessels, their tackle, apparel, and the furniture, and the master and owners thereof, are jointly and severally liable for pilotage fees, to be recovered in any court of competent jurisdiction.—*Political Code*, page 443, Section 2432.

Every pilot on boarding a vessel, when required by the master thereof, must exhibit his commission as pilot. A refusal so to do subjects him to a forfeiture of his commission or license, and a recovery of fifty dol-

lars on his bond, in a suit instituted for that purpose by the authority appointing him.—*Political Code*, page 444, Section 2134.

Every pilot carried to sea against his will, or unnecessarily detained on board of a vessel, when a pilot boat is in attendance to receive him, is entitled to receive the sum of eight dollars per day while necessarily absent or detained, not to exceed in the aggregate the sum of one thousand dollars in any one case, which sum may be recovered by an action against the master or owner of the vessel so taking him away.—*Political Code*, page 444, Section 2435.

Every pilot in charge of a vessel arriving in the port of San Francisco must safely moor the vessel in such position as the master of the vessel or Harbor Master may direct. He must prevent all persons (except officers of the State or Federal Governments, owners or consignees of the vessels or cargo, and persons admitted on the express orders of the master) from boarding such vessel until she has been safely moored. To enforce the provisions of this section and other police regulations for the harbor of San Francisco, every pilot in charge of a vessel entering the harbor of San Francisco is authorized and empowered to arrest everyone who in opposition to the master's orders persists in boarding such vessel, or who, having boarded her, refuses to leave on the command of such master or pilot; when so arrested, he must be immediately brought before the Police Judge's Court, or admitted to bail, as provided in the Penal Code.—*Political Code*, vol. 1, page 449, Section 2459.

The pilotage inside the Heads to the anchorage opposite San Francisco, and about the harbor or between the harbor of San Francisco and the ports of Mare Island, Vallejo or Benicia, must be at such rates as agreed on between the parties, not to exceed five dollars per foot draught.—*Political Code*, page 452, Section 2465.

The following are the rates of pilotage into or out of the harbor of San Francisco: Vessels under five hundred tons, five dollars per foot draught; vessels over five hundred tons, five dollars per foot draught and four cents per ton for each and every ton of registered measurement; vessels engaged in the whaling or fishing trade, one dollar per foot draught. When a vessel is spoken and the services of a pilot are declined, one half of the rates must be paid. If the vessel is inward bound, the above rates and one-half rates in this section mentioned are chargeable only when the vessel is spoken off the entrance to the harbor and outside of the bar. In all cases where inward bound vessels are not spoken until inside of the bar, the rates of pilotage and one-half pilotage must be reduced fifty per cent.—*Political Code*, vol. 1, page 452, Section 2466.

Any vessel in tow of a steam tug, outward bound, or between the harbor of San Francisco and the ports of Mare Island, Vallejo or Benicia, is not liable for pilotage unless a licensed pilot is actually employed. If a pilot is employed by any outward bound vessel, in tow of a steam tug, not licensed, the rates of pilotage are one-half the rates specified in the preceding section.—*Political Code*, page 452-3, Section 2467.

All vessels coasting between San Francisco and any port in Oregon, or in Washington or Alaska Territories, and all vessels coasting between ports of this State, are exempt from all charges of pilotage, unless a pilot is actually employed. A steam-tug pilot boat is in no case allowed to charge for pilotage or towage, unless the service of such boat is actually accepted.—*Political Code*, page 452, Section 2468.

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## Extracts of the Health and Quarantine Laws for the Harbor of San Francisco.—January 1st, A. D. 1873.

The quarantine grounds of the bay and harbor of San Francisco, are at the anchorage of Saucelito.—*Political Code*, vol. 1, page 562, Section 3004.

Shipmasters bringing vessels into the harbor of San Francisco, and masters, owners, or consignees, having vessels in the harbor which have on board any cases of Asiatic cholera, small pox, yellow fever, typhus or ship fever, must report the same in writing to the Health Officer before landing any passengers, casting anchor, or coming to any wharf, or as soon thereafter as they, or either of them, become aware of the existence of either of these diseases on board of their vessels.—*Political Code*, vol. 1, page 564, Section 3013.

No Captain or other officer in command of any vessel sailing under a register, arriving at the Port of San Francisco, nor any owner, consignee, agent or other person having charge of such vessel, must, under a penalty of not less than one hundred dollars, land, or permit to be landed, any freight, passengers, or other persons, from such vessel until he has reported to the Health Officer, presented his bill of health, and received a permit from that officer to land freight, passengers, or other persons.—*Political Code*, vol. 1, page 565, Section 3014.

Every pilot who conducts into the port of San Francisco any vessel subject to quarantine or examination by the Health Officer, must:

*First.*—Bring the vessel no nearer the city than is allowed by law.

*Second.*—Prevent any person from leaving, and any communication being made with the vessel under his charge, until the Health Officer has boarded her and given the necessary orders and directions.

*Third.*—Be vigilant in preventing any violation of the quarantine laws, and report without delay all such violations that come to his knowledge to the Health Officer.

*Fourth.*—Present the master of a vessel with a printed copy of the quarantine laws, unless he has one.

*Fifth.*—If the vessel is subject to quarantine, by reason of infection, place at the masthead a small yellow flag.—*Political Code*, Vol. 1, page 565, Section 3015.

Every master of a vessel, subject to quarantine, or visitation by the Health Officer, arriving in the port of San Francisco, who refuses or neglects either:

*First.*—To proceed with and anchor his vessel at the place assigned for quarantine, when legally directed so to do; or,

*Second.*—To submit his vessel, cargo, and passengers to the Health Officer, or furnish all necessary information to enable that officer to determine what quarantine or other regulations they ought respectively to be subject to; or,

*Third.*—To report all cases of diseases and deaths occurring on his vessel, and to comply with all the sanitary regulations of the bay and harbor, is liable in the sum of five hundred dollars for every such neglect or refusal.—*Political Code*, page 566, Section 3016.

All vessels arriving off the port of San Francisco from ports which have been legally declared infected ports, or all vessels arriving from ports where there is prevailing at the time of their departure any contagious, infectious or pestilential diseases, or vessels with decaying cargoes, or which have unusually foul or offensive holds, are subject to quarantine, and must be by the master, owner, pilot, or consignee, reported to the Health Officer without delay. No such vessel must cross a right line drawn from Meiggs' Wharf to Alcatraz Island until the Health Officer has boarded her and given the order required by law.—*Political Code*, page 566, Section 3017.

The Health Officer must board every vessel subject to quarantine or visitation by him, immediately on her arrival, make such examination and inspection of vessel, books, papers, or cargo, or of persons on board, under oath, as he may judge expedient, and determine whether the vessel should be ordered to quarantine, and if so, the period of quarantine.—*Political Code*, page 566, Section 3018.

No captain or other officer in command of any passenger-carrying vessel of more than one hundred and fifty tons burden, nor of any vessel of more than one hundred and fifty tons burden having passengers on board, nor any owner, consignee, agent, or other person having charge of such vessel or vessels, must, under penalty of not less than

one hundred dollars, nor more than one thousand dollars, land or permit to be landed any passenger from the vessel until he has presented his bill of health to the Health Officer and received a permit from that officer to land such passenger, except in such cases as the Health Officer deems it safe to give the permit before seeing the bill of health.—*Political Code*, page 567, Section 3019.

The following fees may be collected by the Health Officer: For giving a permit to land freight or passengers, or both, from vessels of less than one thousand tons burden, from any port out of this State, two and a half dollars; from any port in this State, one dollar and a quarter; from any passenger-carrying vessel of more than one thousand tons burden, three dollars and seventy-five cents; for vessels of more than one thousand tons burden, carrying no passengers, two dollars and fifty cents; for vaccination of each person, one dollar.—*Political Code*, page 567, Section 3020.

The Board of Health may enforce compulsory vaccination on passengers in infected ships, or coming from infected ports.—*Political Code*, Vol. 1, page 567, Section 3021.

Whenever any cause of action arises under any one of the provisions of this chapter, suit may be maintained thereon in the name of the Health Officer, in any District Court in this State.—*Political Code*, Vol. 1, page 570, Section 3032.

## Extracts of the Harbor Police Laws.

No person shall board or attempt to board any vessel arriving in the harbor of the City and County of San Francisco, before said vessel has been made fast to the wharf, without obtaining leave from the master or other person having charge of said vessel, or permission in writing, from the owner or owners, or the agent thereof; or having boarded such vessel, shall refuse or neglect to leave the same upon request of the master or other person in charge thereof, under the penalty prescribed in the next succeeding Section of this Act.

Any person violating Section one of this Act shall be deemed guilty of a misdemeanor; and upon conviction thereof before the Police Judge's Court of said city and county, shall be punished for each offense by a fine not exceeding one hundred dollars, or imprisonment in the County Jail of the City and County of San Francisco for a term not exceeding fifty days, or both, in the discretion of the Judge of the said Police Judge's Court, which Court shall have jurisdiction in such cases.

The provisions of the last two foregoing Sections shall not apply to any pilot or public officer visiting a vessel, in discharge of his duty.

The word "harbor," as used in this Act, shall be held to mean and include all the waters of the Bay of San Francisco, within the limits of the City and County of San Francisco; and the word "vessel," as used in this Act, shall be held to mean and include all vessels propelled by steam or sails, plying or bound on a voyage between the said port of San Francisco and any other port in this State, or in any other State of the United States, or in any foreign country.

HARBOR POLICE SIGNALS.

Between sunrise and sunset, the national flag in the mizzen rigging; and between sunset and sunrise, a green or blue light, at least twelve feet above deck.

WM. H. KENTZEL,
Capt. of Harbor Police.

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**Extracts of General Laws.**

Every captain, master of a vessel, or other person, who willfully imports, brings, or sends, or causes or procures to be brought or sent, into this State, any person who is a foreign convict of any crime which, if committed within this State, would be punished therein (treason and misprision of treason excepted), or who is delivered or sent to him from any prison or place of confinement in any place without this State, is guilty of a misdemeanor.—*Penal Code*, page 75, Section 173.

Every person bringing or landing within this State any person born either in the Empire of China or Japan, or the islands adjacent to the Empire of China, without first presenting to the Commissioners of Immigration evidence satisfactory to such Commissioners that such person desires voluntarily to come into this State, and is a person of good character, and obtaining from such Commissioners a permit describing such person and authorizing the landing, is punishable by a fine of not less than one nor more than five thousand dollars, or by imprisonment in the County Jail not less than two nor more than twelve months.—*Penal Code*, page 76, Section 174.

Every master of a vessel subject to quarantine or visitation by the Health Officer, arriving in the port of San Francisco, who refuses or omits: *First.* To proceed and anchor his vessel at a place assigned for quarantine at the time of his arrival; or, *Second.* To submit his vessel, cargo and passengers to the examination of the Health Officer, and to furnish all necessary information to enable that officer to determine to what length of quarantine and other regulations they ought respectively to be subject; or, *Third.* To remain with his vessel at quarantine during the period assigned for her quarantine, and while at quarantine

to comply with the regulations prescribed by law and with such as any of the officers of health, by virtue of authority given them by law, shall prescribe in relation to his vessel, his cargo, himself, his passengers or crew, is punishable by imprisonment in the County Jail not exceeding one year, or by fine not exceeding two thousand dollars, or both.—*Penal Code*, page 152, Section 376.

Every person who, within the anchorage of any port, harbor, or cove of this State, into which vessels may enter for the purpose of receiving or discharging cargo, throws overboard from any vessel the ballast, or any part thereof, or who otherwise places, or causes to be placed, in such port, harbor, or cove, any obstructions to the navigation thereof, is guilty of a misdemeanor.—*Penal Code*, page 226, Section 613.

Every person who entices seamen to desert from any vessel lying in the waters of this State, and on board of which they have shipped for a term or voyage unexpired at the time of such enticement, is guilty of a misdemeanor.—*Penal Code*, page 237, Section 644.

Every person who harbors or secretes any seaman, knowing him to be shipped, and with a view to persuade him to desert, is guilty of a misdemeanor.—*Penal Code*, page 237, Section 645.

When steamers meet, each must turn to the right, so as to pass without interference.—*Political Code*, Vol. 1, page 429, Section 2360.

When any steamer is running in the night time, her master must cause her to carry two conspicuous lights, one exposed near her bow, and the other near her stern; the latter must be at least twenty feet above her deck.—*Political Code*, Vol. 1, page 430, Section 2366.

The owners of every steamboat are responsible for the good conduct of the master or other person in charge employed by them, and they are jointly and severally liable for every penalty incurred by the master, engineer, or other person in charge, which can not be collected from him by due course of law, as if they were his sureties.—*Political Code*, Vol. 1, page 433, Section 2378.

If any master, owner, agent, or other person having charge or control of any ship, or other vessel, shall refuse or neglect to obey the directions of the Harbor Master, in matters pertaining to the regulations of said port, or removal and stationing any vessel therein, such master, owner, agent, or other person, so refusing or neglecting, shall forfeit and pay a sum not exceeding five hundred dollars, to be recovered, with costs of suit, before either the Fourth or Twelfth District Courts, or not exceeding two hundred dollars, if sued for before the Police Judge, upon whom full and ample jurisdiction in such cases is hereby conferred, or any Justice of the Peace in said city and county, by an action in the name of the city and county, and said Harbor Master shall be a

competent witness in the case, and for the amount which shall be recovered such steamer, ship, or other vessel, and the owners thereof, shall be liable.—*Harbor Master Law* of 1857.

Three State Harbor Commissioners.—*Political Code*, Vol. 1, page 96, Section 343

They have possession of all that portion of the Bay of San Francisco along the water-front of the City and County of San Francisco, and adjacent thereto, to the distance of six hundred feet into the waters of the bay from the line of the water-front, as defined by an Act of the Legislature of this State, approved March 26th, A. D. 1851, together with all of the improvements, rights, privileges, franchises, easements and appurtenances connected therewith or in anywise appertaining thereto, excepting such portions of the water-front as are held under valid leases, and must also take possession and have the control of any and all such portions of the water-front, with the improvements, rights, privileges, franchises, easements and appurtenances, as are held under valid leases, if any exist, as soon as the leases respectively expire or become void.—*Political Code*, page 467, Section 2522.

The harbor of San Francisco is hereby placed under the control of the Board of State Harbor Commissioners, and they are authorized to regulate the position of ships, their moorings and anchorage, and generally to make rules and regulations concerning them, with power to enforce the same as fully as that formerly used and exercised by the Harbor Master of the City and County of San Francisco.—*Approved March 30th*, 1874.

The Commissioners shall keep the routes of the ferry-boats passing in and out of said harbor free and open at all times, so that ferry-boats can conveniently make their trips without impediment on the part of vessels at anchor or other obstructions. The present Harbor Master of the City and County of San Francisco . . . . . shall, during his term of office, perform such services in and about the management and regulation of said harbor as the Commissioners may require of him.—*Approved March 30th*, 1874.

Every person who collects any tolls, wharfage or dockage, or lands, ships, or removes any property upon or from any portion of the water-front of San Francisco, or from or upon any of the wharves, piers, or landings under control of the Board of State Harbor Commissioners, without being by such board authorized so to do, is guilty of a misdemeanor.—*Penal Code*, page 236, Section 642.

Every person who attempts, by means of any threat or violence, to deter or prevent an executive officer from performing any duty imposed upon such officer by law, or knowingly resists, by the use of force or

violence, such officer in the performance of his duty, is punishable by fine not exceeding five thousand dollars, and imprisonment in the County Jail not exceeding five years.—*Penal Code*, page 45, Section 69.

Every person who willfully resists, delays or obstructs any public officer in the discharge, or attempt to discharge, any duty of his office, when no other punishment is prescribed, is punishable by fine not exceeding five thousand dollars, and imprisonment in the County Jail not exceeding five years.—*Penal Code*, page 67, Section 148.

Every person who willfully obstructs or hinders any public officer from collecting any revenue, taxes, or other sums of money in which the people of this State are interested, and which such officer is by law empowered to collect, is guilty of a misdemeanor.—*Penal Code*, page 148, Section 428.

[Wharfingers and Toll Collectors are public officers.]

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**Harbor Rules and Regulations made by the Board of State Harbor Commissioners, by Authority of an Act Approved March 30th, A. D. 1874, and to take effect on the 1st day of July, 1874.**

Rule 1st.—Vessels must not be anchored or moored between a line drawn from the end of Pacific-street Wharf to the most southerly end of Goat Island and a line drawn from the end of Mission-street Wharf to the point where the southerly end of the Central Pacific Railroad Wharf connects with the Oakland shore, nor must they be anchored in such manner as to permit them to swing between said lines.

Rule 2d. Vessels must not be anchored or moored within five hundred yards of a line drawn from the out-shore end of Meiggs' Wharf, southerly along the ends of the wharves, to the out-shore end of Third-street Wharf.

Rule 3d.—Vessels must not be moored in such manner as to interfere with vessels approaching or leaving the wharves, and vessels moored in the slips between Market-street and Folsom-street wharves must be stationed not less than one hundred and twenty feet from the wharves.

Rule 4th.—Applications for berths must be made to the Chief Wharfinger, the applicant giving the draught of the vessel and kind of cargo to be loaded or discharged; and in no case must a berth be assigned by a person other than the Chief Wharfinger.

Rule 5th.—Vessels, when being moved into a slip or alongside of a wharf, must approach "head on," and when at a wharf must lie head toward the shore. Their studding-sail booms and boom-irons must

be removed from their yards; their spritsail yards must be rigged in; their off-shore anchors suspended ready for dropping; their lower and topsail yards braced "sharp up" on their off-shore braces, excepting when in actual use discharging or loading cargo, and when required by the Chief Wharfinger their movable fore-and-aft spars and martingale must be rigged in.

RULE 6th.—Vessels ready to discharge cargoes given the preference over those ready to receive cargo.

RULE 7th.—Persons in charge of vessels must haul such vessels, when required to do so, to make room for vessels requiring immediate accommodations. And vessels lying at the ends of wharves must be hauled each way to permit others to be hauled in and out of the slips.

RULE 8th.—Vessels anchored or moored in the harbor, or lying in a slip or dock, must, at all times, as well by night as by day, have on board at least one seaman capable of taking proper care of such vessel. If a vessel shall be required to be removed, and no such person is on board, such vessel may be removed by the Harbor Master or Chief Wharfinger at the expense of the owner of such vessel, and the owner and the vessel shall be liable for all damages that shall arise thereby.

RULE 9th.—When ballast, stones, coals, bricks, ashes, cinders, dust, rubbish, or other loose matter or thing that will sink, is being landed from a vessel upon a wharf or landing, or is being transferred from one vessel into another vessel, a canvas, or shoot, or other contrivance, to the satisfaction of the Chief Wharfinger or Harbor Master, as the case may be, must be used to prevent any part of such substance falling into the harbor.

RULE 10th.—Fire must not be used on board of any vessel for heating pitch, tar, or other inflammable substance, but may be used on floating stages or boats for the purpose of heating such substances for repairing vessels: Provided such fire is constantly in the care of a person capable of taking proper care of the same.

RULE 11th.—Vessels having more than twenty-five pounds of gunpowder or other explosive substances on board, must discharge the same north of Vallejo Street, and not less than five hundred yards off-shore, before such vessel approaches any slip, dock, or wharf.

RULE 12th.—Every steam engine, when used upon any wharf or landing for loading or unloading cargo, must have upon their smoke-stack a bonnet or spark-catcher that will effectually prevent sparks falling upon such wharf or landing, or upon the deck of any vessel.

RULE 13th.—All coal screens, when in use upon any wharf or landing, must have their sides so covered as to effectually prevent the escape of coal dust.

RULE 14th.—The number of piles, or pieces of timber, permitted to be unloaded from the same vessel into any slip or dock, before being removed, not to exceed one hundred, and none allowed to remain in a dock or a slip during the night without the permission of the Chief Wharfinger.

RULE 15th.—All condemned or dismantled vessels must be moved at such places as the Chief Wharfinger shall designate.

RULE 16th.—Stone, sand, earth, rubbish, or other matter that will sink, must not be deposited upon the shore of the harbor, where from any cause it will be carried into the waters thereof, nor must any such substance be thrown into the harbor without the permission of the Board.

RULE 17th.—All rubbish or other substance landed upon a wharf or landing on which wharfage is not charged, must be removed therefrom by the party landing the same, and if not removed by such party, will be removed by the Wharfinger at the expense of such party.

## RATES OF DOCKAGE, WHARFAGE, AND TOLLS,

FOR THE PORT OF SAN FRANCISCO.

*Established by the Board of State Harbor Commissioners, July 1st, 1874.*

DOCKAGE.

| Vessels | Per Day. | Vessels | Per Day. |
|---|---|---|---|
| Under 10 tons..... | $0 50 | 900 tons and und. 1000 tons | $11 50 |
| 10 tons and under 25 tons | 0 75 | 1000 " " 1100 " | 12 50 |
| 25 " " 50 " | 1 25 | 1100 " " 1200 " | 13 50 |
| 50 " " 75 " | 1 50 | 1200 " " 1300 " | 14 50 |
| 75 " " 100 " | 2 00 | 1300 " " 1400 " | 15 50 |
| 100 " " 150 " | 3 00 | 1400 " " 1500 " | 16 50 |
| 150 " " 200 " | 4 00 | 1500 " " 1600 " | 17 50 |
| 200 " " 250 " | 5 00 | 1600 " " 1700 " | 18 50 |
| 250 " " 300 " | 6 00 | 1700 " " 1800 " | 19 50 |
| 300 " " 400 " | 7 00 | 1800 " " 1900 " | 21 00 |
| 400 " " 500 " | 8 00 | 1900 " " 2000 " | 22 50 |
| 500 " " 600 " | 8 50 | 2000 " " 2200 " | 23 50 |
| 600 " " 700 " | 9 50 | 2200 " " 2500 " | 25 00 |
| 700 " " 800 " | 10 50 | And 50 cents for each additional | |
| 800 " " 900 " | 11 00 | 100 tons. | |

Vessels loading and ballasting, half the above rates.

Vessels, after being discharged, may lie at the wharves at half rates, subject to the orders of the Chief Wharfinger.

All vessels in outside berths, or in the slips, or within premises in the possession and under the control of the Board of State Harbor Commissioners, must pay half rates of dockage.

Dockage to commence upon a vessel making fast to a wharf, or com-

ing within said premises, and to pay for each day or fractional part thereof as a full day. No deduction to be made for Sundays, holidays, or rainy days.

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## TOLLS.

| | |
|---|---|
| Vehicles drawn by one or more animals, with loads not exceeding two tons weight or 80 cubic feet | 12½ cts. |
| Loads in excess of two tons, for each additional ton or part thereof | 6¼ " |
| Excepting Grain, Flour, Potatoes, and other vegetables, which pay for each additional ton or part thereof | 5 " |
| Lumber, when hauled on the wharves in loads of 2,000 feet or less | 12½ " |
| Lumber landed upon the wharves or bulkhead, per 1,000 feet board measure | 10 " |
| Wood, per cord | 12½ " |
| Bricks, per 1,000 | 10 " |
| Coal and Asphaltum, per ton | 10 " |
| Iron, per ton | 10 " |
| Stone and Ballast, per ton | 6¼ " |
| Hay, per ton of 2,000 lbs | 10 " |
| Vehicles, for transportation | 12½ " |
| Wool, in bags, 3 cents; in bales, strapped, 4 cents. | |
| Dry Hides, ¼ cent. | |
| General merchandise, per cargo, per ton of 40 cubic feet, or 2,000 lbs., in advance | 6¼ " |
| Cattle and Horses, for transportation, each | 5 " |
| Calves, each | 2½ " |
| Sheep and Hogs, each | 1½ " |
| Handcarts, each, | 5 " |

Loads must be estimated either by weight or measurement, as will yield the largest revenue—2,000 lbs. or 40 cubic feet to constitute a ton, excepting Coal, Pig Iron, Asphaltum and Stone, for which 2,240 lbs. will be a ton.

Tolls must be paid on each load as delivered or received; provided, however, *that owners or consignees may pay in advance the tolls upon entire cargoes, at schedule rates.*

All merchandise landed upon wharves from vessels, and taken from thence in lighters or other vessels, or warehoused without drayage, must pay 6¼ cents per ton wharfage.

All merchandise received or discharged from vessels lying at the wharves or within that portion of the harbor subject to the jurisdiction of the Board of State Harbor Commissioners, into or from lighters or other vessels, must pay five cents per ton, and bricks five cents per thousand. Lumber discharged into the water must pay five cents per thousand feet, and piles three cents each. All timber and piles discharged into the slips must be removed within twenty-four hours from the time of such discharge.

All merchandise landed upon the wharves must be removed the same day landed; provided, however, *that by the consent of the wharfinger, and at the risk of the owner, it may remain from day to day, subject to an additional toll for wharfage for every forty-eight hours, or part thereof.*

All merchandise remaining on the wharves after the owner, agent, or consignee has been notified to remove the same, will be removed by the wharfinger at the expense and risk of the owner.

Vessels and their owners are liable for dockage, and all merchandise is liable for tolls and may be held by the wharfinger to secure the payment thereof.

No load exceeding five tons shall be admitted on or off the wharves, except single packages.

Driving on any wharf or thoroughfare faster than a walk, prohibited, and a non-observance of this rule will subject the offender to a prosecution for misdemeanor.

Parties holding part of the water-front, under lease from the Board of State Harbor Commissioners, are obligated to charge and collect the above rates, and any person violating said rules will forfeit his lease.

By order of the Board of State Harbor Commissioners.

J. A. McCLELLAND, SECRETARY.

## Board of Port Wardens.

It is the duty of the *Port Wardens* to survey the hatches, stowage and cargo of all vessels arriving at the port of San Francisco, laden with general or assorted merchandise, belonging to, or consigned to various parties; also, to survey all vessels arriving in distress, or which have sustained damage at sea, whether to sails, rigging, spars, hull, or otherwise, caused by stress of weather, stranding, collision, or other accident

A penalty of not less than five hundred nor more than one thousand dollars, is imposed for the violation of the law under which the Wardens act, (which provides that none but Port Wardens shall hold surveys); they will, however, in marine surveys, recognize and co-op-

erate with such parties as may be designated by the representatives of foreign governments, underwriters, and owners or consignees of vessels.

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### Telegraph Cables in San Francisco Harbor.

The following landmarks, or monuments, have been erected to indicate the telegraph cable crossing near Benicia.

On the small island opposite Benicia there is a pole, about ten (10) feet high, with a white sign at the end of the pole, lettered "telegraph cable crosses here."

There is a similar pole and sign in a small ravine or cove on the Contra Costa shore, nearly opposite said island, a little below it, down stream.

The cable extends from the small island aforesaid to the monument on the Contra Costa side.

All persons or vessels damaging or breaking this cable, whether by dragging anchors or otherwise, will be promptly prosecuted. The penalty fixed by law is a fine of not less than five hundred nor more than ten thousand dollars, to which are added full damages arising from injury done the cable.

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### Passenger Act of the State of California.

The Passenger Act of the State of California requires *all masters or commanders of vessels, arriving from ports outside of the State of California,* to make report to the Commissioner of Immigration, within twenty-four hours of arrival. This report is to contain the names of all persons or passengers on board who may be naturalized citizens of the United States; also, their age, nativity, occupation, place and date of naturalization. The report must also contain the names, ages, nationality, and occupation of all persons or passengers on board, not citizens of the United States. Masters or commanders of vessels are to require all persons claiming to be naturalized citizens to make oath or to affirm the same, giving the time and place where said naturalization took place.

Special bonds are required for all "lunatic, deaf, dumb, blind, crippled, or infirm persons, whose circumstances make it probable they will become a burden on the State." The penalty for non-report is $200, and $200 per alien passenger not reported.

## Act of Congress to Authorize the Appointment of Shipping Commissioners,

*By the several Circuit Courts of the United States, to superintend the shipping and discharge of seamen engaged in merchant ships belonging to the United States, and for the further protection of seamen.*

(CONDENSED AND CLASSIFIED.)

AGREEMENT.—The master of every ship bound from a port in the United States to any foreign port, or of any ship of the burden of seventy-five tons or upwards, bound from a port on the Atlantic to a port on the Pacific, or *vice versa*, shall, before he proceeds on such voyage, make an agreement, in writing or print, with every seaman whom he carries to sea as one of the crew, which agreement shall be dated at the time of the first signature thereof, and shall be signed by the master before any seaman signs the same, and shall contain the following particulars: First, the nature, and as far as practicable, the duration of the intended voyage or engagement, and the port or country at which the voyage is to terminate; Secondly, the number and description of the crew, specifying their respective employments; Thirdly, the time at which each seaman is to be on board to begin work; Fourthly, the capacity in which each seaman is to serve; Fifthly, the amount of wages; Sixthly, a scale of the provisions to be furnished to each man; Seventhly, any regulations as to conduct on board, and as to fines, short allowance of provisions, or other lawful punishment for misconduct; Eighthly, any stipulation in reference to advance and allotment of wages.

Every agreement shall be signed by each seaman in the presence of a Shipping Commissioner, and shall be acknowledged under his seal.

The master shall, at the commencement of each voyage, cause a legible copy of the agreement to be posted up in such part of the ship as may be accessible to the crew, under penalty of a fine of one hundred dollars.

APPRENTICES.—No apprentice shall be taken to sea without being previously taken before the Commissioner, to whom the indenture must be produced.

CLOTHING.—Every vessel bound to a foreign port shall be provided with at least one suit of woolen clothing for each seaman; also weights and measures for determining the quantity of provisions served out.

Fees.—All fees are to be paid by the master or agent to the Commissioner.

Fuel.—Every vessel bound to a foreign port must be provided with fuel and a safe and suitable room in which a fire can be kept for the use of seamen.

Log Book.—The master of every vessel bound to a foreign port shall have an Official Log Book in which he shall keep a record of all matters relating to his crew, such as offenses and their punishments, injuries, deaths, etc.

Medicines.—Every vessel shall be provided with a chest of medicines, and those bound across the Atlantic or Pacific, or around Cape Horn or the Cape of Good Hope, shall be provided with a sufficient quantity of lime juice, also sugar and vinegar, or other anti-scorbutics.

Provisions shall be of good quality, sufficient in quantity, and in accordance with the agreement.

Seamen.—The master shall deliver to the Commissioner a full and true account of the wages of each seaman, with all deductions to be made therefrom, and shall give him a certificate of discharge. Any seaman who has signed an agreement and is discharged without his consent or fault, shall be entitled to receive one month's wages in addition to any wages he may already have earned. If a seaman dies on board the master shall take charge of his money and effects, and shall, if he thinks fit, cause them to be sold by auction at the mast, making entry of all particulars in the Official Log Book, and on arrival in port, give an account and pay all moneys and balance of wages due to deceased, to the Shipping Commissioner, or in a foreign port, to the consul. The penalties for the various offenses of which he may be guilty are imprisonment and forfeiture of wages.

Shipping Commissioner.—The general business of the Commissioner shall be to afford facilities for engaging seamen by keeping a register of their names and characters; to superintend their engagement and discharge: to provide means for securing their presence on board, and to facilitate the making of apprentices to the sea service. He shall hear and decide any question between a master, owner, or consignee, and any of the crew, and any award so made by him shall be binding on both parties.

Wages.—No advance of wages shall be made or advance security given to any person but the seamen himself, or to his wife or mother, and not then unless the agreement contains a stipulation for the same, and in each case must be made in the presence of the Commissioner. All

wages must be paid to a discharged seaman in the presence of the Commissioner.

AMENDMENT TO ABOVE ACT, Approved June, 1874.—None of the provisions of this Act shall apply to sail or steam vessels, engaged in the coastwise trade, except the coastwise trade between the Atlantic and Pacific Coasts, or in the lake-going trade, touching at foreign ports or otherwise, or in the trade between the United States and the British North American possessions, or in any trade where the seamen are by custom or agreement entitled to participate in the profit or results of a cruise.

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## Act of Congress to prevent Collisions at Sea.

[Approved, April, 1864.]

BE IT ENACTED, *by the Senate and House of Representatives of the United States of America, in Congress assembled:*

That from and after September 1, 1864, the following rules and regulations for preventing collisions on the water be adopted in the Navy and Mercantile Marine of the United States; *provided*, that the exhibition of any light on board of a vessel of war of the United States may be suspended whenever, in the opinion of the Secretary of the Navy, the commander-in-chief of a squadron, or the commander of a vessel acting singly, the special character of the service may require it.

### PRELIMINARY.

ARTICLE 1. In the following rules every steamship which is under sail and not under steam is to be considered a sailing ship; and every steamship which is under steam, whether under sail or not, is to be considered a ship under steam.

### RULES CONCERNING LIGHTS.

*Lights.*

ART. 2. The lights mentioned in the following articles, and *no* others, shall be carried in all weathers between sunset and sunrise.

*Lights for Steamships.*

ART. 3. All steam vessels, when under way, shall carry—

(*a.*) At the foremast-head a bright *white* light, so constructed as to show a uniform and unbroken light over an arc of the horizon of twenty

points of the compass; so fixed as to throw the light ten points each side of the ship, viz: from right ahead to two points abaft the beam on either side, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of at least *five* miles.

(*b.*) On the *starboard* side a *green* light so constructed as to show a uniform and unbroken light over an arc of the horizon of ten points of the compass; so fixed as to throw the light from right ahead to two points abaft the beam on the *starboard* side, and of such a character as to be visible on a dark night with a clear atmosphere, at a distance of at least *two* miles.

(*c.*) On the *port* side a *red* light, so constructed as to show a uniform and unbroken light over an arc of the horizon of ten points of the compass; so fixed as to throw the light from right ahead to two points abaft the beam on the *port* side, and of such a character as to be visible on a dark night with a clear atmosphere, at a distance of at least *two* miles.

(*d.*) The said green and red lights shall be fitted with inboard screens projecting at least three feet forward from the light, so as to prevent these lights from being seen across the bow.

*Lights for Steam Tugs.*

ART. 4. Steamships when towing other ships, shall carry *two* bright *white* mast-head lights vertically, in addition to their side lights, to distinguish them from other steamships. Each of these mast-head lights shall be of the same construction and character as the mast-head lights which other steamers are required to carry.

*Lights for Sailing Ships.*

ART. 8. Sailing ships under way or being towed, shall carry the same lights as steamships under way, with the exception of the *white* mast-head lights, which they shall never carry.

*Exceptional Lights for Small Sailing Vessels.*

ART. 9. Whenever, as in the case of small vessels during bad weather, the green and red lights cannot be fixed, these lights shall be kept on deck, on their respective sides of the vessel, ready for instant exhibition, and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the *green* light shall not be seen on the *port* side, nor the *red* light on the *starboard* side.

To make the use of these portable lights more certain and easy, they shall each be painted on the outside with the color of the light they respectively contain, and shall be provided with suitable screens.

*Lights for Ships at Anchor.*

ART. 10. Ships, whether steamships or sailing ships, when at anchor in roadsteads or fairways, shall, between sunset and sunrise, exhibit where it can best be seen, but at a height not exceeding twenty feet above the hull, a *white* light in a globular lantern of eight inches in diameter, and so constructed as to show a clear, uniform, and unbroken light, visible all around the horizon, and at a distance of at least *one* mile.

*Lights for Pilot Vessels.*

ART. 11. Sailing pilot vessels shall not carry the lights required for other sailing vessels, but shall carry a *white* light at the mast-head, visible all around the horizon, and shall also exhibit a *flare-up* light every fifteen minutes.

*Lights for Fishing Vessels and Boats.*

ART. 13. Open fishing boats and other open boats shall not be required to carry side lights required for other vessels, but shall, if they do not carry such lights, carry a lantern with a *green* light on the one side, and a *red* light on the other side, and on the approach of or to other vessels, such lantern shall be exhibited in sufficient time to prevent collision, so that the *green* light shall not be seen on the *port* side, nor the *red* light on the *starboard* side. Fishing vessels and open boats when at anchor, or attached to their nets and stationary, shall exhibit a bright *white* light. Fishing vessels and open boats shall, however, not be prevented from using a *flare-up* in addition, if considered expedient.

RULES GOVERNING FOG SIGNALS.

*Fog Signals.*

ART. 15. Whenever there is a fog, whether by day or night, the fog signals described below shall be carried and used, and shall be sounded every five minutes, viz:

(*a.*) *Steamships* under way shall sound a *steam whistle*, placed before the funnel, not less than eight feet from the deck, at intervals of not more than one minute.

(*b.*) *Sailing Ships* under way shall sound a *fog horn* at intervals of not more than five minutes.

(*c.*) *Steamships* and *sailing ships*, when not under way, shall sound a *bell* at intervals of not more than five minutes.

STEERING AND SAILING RULES.

*Two Sailing Ships Meeting.*

ART. 16. If two sailing ships are meeting end on, or nearly end on,

so as to involve risk of collision, the helms of both shall be put to *port*, so that each shall pass on the *port* side of the other.

*Two Sailing Ships Crossing.*

ART. 17. When two sailing ships are crossing so as to involve risk of collision, then, if they have the wind on different sides, the ship with the wind on the *port* side shall keep out of the way of the ship with the wind on the *starboard* side, except in the case in which the ship with the wind on the *port* side is *close-hauled*, and the other ship *free*, in which case the latter ship shall keep out of the way. But if they have the wind on the *same* side, or if one of them has the wind *aft*, the ship which is to *windward* shall keep out of the way of the ship which is to *leeward*.

*Two Ships under Steam, Meeting.*

ART. 18. If two ships under steam are meeting end on, or nearly end on, so as to involve risk of collision, the helms of both shall be put to *port* so that each may pass on the *port* side of the other.

*Two Ships under Steam, Crossing.*

ART. 19. If two ships under steam are crossing, so as to involve risk of collision, the ship which has the other on her own *starboard* side shall keep out of the way of the other.

*Sailing Ship and Ship under Steam.*

ART. 20. If two ships, one of which is a sailing ship and the other a steamship, are proceeding in such directions as to involve risk of collision, the steamship shall keep out of the way of the sailing ship.

*Ship under Steam to slacken Speed.*

ART. 21. Every *steamship*, when approaching another ship, so as to involve risk of collision, shall slacken her speed, or if necessary, stop and reverse; and every steamship shall, when in a fog, go at a moderate speed.

*Vessels Overtaking other Vessels.*

ART. 22. Every vessel overtaking any other vessel, shall keep out of the way of the said last mentioned vessel.

*Construction of Articles* 17, 19, 20, *and* 22.

ART. 23. Where, by the preceding rules, one of two ships is to keep out of the way, the other shall keep her course, subject to the qualifications contained in the following article:

*Proviso to save Special Cases.*

ART. 24. In obeying and construing these rules, due regard must be had to all dangers of navigation, and due regard must also be had to any special circumstances which may exist in any particular case, rendering a departure from the above rules necessary, in order to avoid immediate danger.

The following circular was issued by the Secretary of the Treasury, June 6, 1871, addressed to Collectors and other officers of Customs, relating to an amendment (approved February 28, 1871) of the Act of Congress of 1864, to prevent collisions at sea.

SECTION 70.—*And be it further enacted*, that it shall be the duty of all Collectors or other chief officers of the Customs, to require all sailing vessels to be furnished with proper signal lights, as provided for by the Act of April 29, 1864, entitled "An Act fixing certain rules and regulations for preventing collisions on the water;" and every vessel shall, on approach of any steamer during the night time, show a lighted torch upon that point or quarter to which such steamer shall be approaching. And every such vessel that shall be navigated without complying with the terms of said Act of April 29, 1864, and the provisions of this section, shall forfeit and pay the sum of $200, one-half to go to the informer, and for which sum the vessel so navigated shall be liable, and may be seized and proceeded against by way of libel, in any District Court of the United States, having jurisdiction of the offense.

GEO. S. BOUTWELL,
Secretary.

## HURRICANES.

[Compiled.]

Hurricanes are caused by a portion of the atmosphere becoming violently heated, and thereby acquiring a circular motion about a centre or focus, and around this focus the wind rushes with great violence. The meteor has also a progressive motion, at a rate varying from twelve to thirty miles per hour. The diameters of these meteors vary from one hundred to three hundred miles. The wind blows with the greatest fury near the centre, and there also the shifts of wind are most rapid; towards the circumference the wind has less force, and the time between the changes is of a greater length.

The places most subject to Hurricanes are the northern limits of the N. E. trade-wind to the eastward of the meridian of the West India

Islands in the N. Atlantic Ocean, and the southern limit of the S. E. trade to the eastward of the meridian of the Island of Mauritius in the S. Atlantic. Hurricanes also occur in the Bay of Bengal and its vicinity, at the change of the Monsoons in May and October.

Hurricanes in the North Atlantic Ocean commence on the northern limits of the N. E. trade-wind, in August and September, and traveling to the westward, visit the West India Islands, and thence pursue a N. E. course parallel with the Gulf Stream, along the coast of the United States of North America. The diameter of this meteor varies from one hundred to two hundred miles, and its progress is at the rate of about seventeen miles an hour. But the most distinctive feature of this Hurricane is, that it blows from *Right* to *Left*, around the focus or centre, it being a calm space.

The Typhoons of the China Sea seem to differ in nothing but name from the Hurricane of the well-frequented seas of the Western Atlantic. They rotate in the same manner (from right to left). They appear to originate in the same latitude, and to travel in the same direction—at first northwestward, till they arrive at the northern limit of the trade-wind, and then turning northeastward, parallel with the coast of China. These storms occur during both Monsoons, but are more violent during the months of June and July.

The S. W. Monsoon commences about the latter end of April, and continues untill October, with much rain and squally weather. Typhoons occur most frequently during this Monsoon. The N. E. Monsoon blows the balance of the year, with generally fine, dry weather. The most terrific Hurricanes frequently occur about the *change* of the Monsoons.

Hurricanes in the South Atlantic commence near the southern limits of the S. E. trades, to the eastward of the Islands of Mauritius, and pursue a course to the westward. These are generally looked for during the month of February or March. The distinctive features of these Hurricanes are that they rotate about a focus from *left* to *right*, contrary to the action of similar winds in the Northern Hemisphere. Every ship navigating seas where Hurricanes are likely to occur, should be provided with a *good* barometer and sympiesometer, and strict attention should be paid to their movements. When the barometer falls to 29.50, the weather threatening, and the clouds of a bluish, gloomy appearance, the ship is on the verge of the storm circle, and the focus may be 150 miles distant. As the focus is approached, the barometer falls to 29.20 inches one hundred miles distant, 28.40 at about fifty miles, and to 28 at thirty miles. Near the focus it is sometimes so low as 27.

There is now less danger in encountering these tempests, owing to

the skill and researches of Redfield, Reed, Piddington, and others, who have collected a vast number of facts bearing upon and elucidating the general laws by which these storms are governed.

## Rules to Avoid Hurricanes.

The vortex of a Typhoon or Hurricane may be avoided, and the ship placed beyond its reach, by the following rule :

Place your back to the wind; then if the vessel be in *North* latitude, the vortex of the Hurricane will be on your *left hand ;* but, if in *South* latitude, it will be on your *right ;* in both cases, at right angles from the direction from which you are looking.

IN NORTH LATITUDE.

| Hurricane Wind. | Bearing of Focus. | When the Path is to the W. N. W. | When the Path is to the N. E. |
|---|---|---|---|
| East..... | South... | Heave to on starboard tack. | Run before the wind until it has shifted to W. from N. and then heave to on port tack. |
| N. E.. .. | S. E..... | Heave to on starboard tack or run before the wind until it has shifted to N. W., then heave to on port tack. | Heave to on port tack. |
| North ... | East..... | Run before the wind until it has shifted to N W., or W. N. W., then heave to on port tack. | If desirable to heave to, do so on port tack. |
| N. W. .. | N.E..... | Heave to on port tack, but in this case the centre will pass very close; better run at discretion and then heave to on port tack. | Here it makes no difference on what tack, as the centre moves at right angles from you. |
| West.... | North. .. | Heave to on port tack. | Heave to on starboard tack |
| S. W.... | N. W.... | Heave to on port tack. | Heave to on starboard tack |
| South... | West.... | Heave to on starboard tack. | Heave to on starboard tack |
| S. E .... | S. W.... | Heave to on starboard tack. | Here your position is right in front of the path; run to the N. W. until it has shifted to the N. of E., then heave to on port tack. |

IN SOUTH LATITUDE.

| Hurricane Wind. | Bearing of Focus. | When the Path is to the W. S. W. | When the Path is to the S. E. |
|---|---|---|---|
| West.... | South... | Heave to on starboard tack. | Heave to on port tack. |
| N. W.... | S. W... | Heave to on starboard tack. | Heave to on port tack. |
| North... | West ... | Heave to on port tack. | Heave to on port tack. |
| N. E.... | N. W.... | Heave to on port tack. | Run before the wind S. W. until it has shifted to E. S.E.,or S.E.,then heave to on starboard tack. |
| East .... | North... | Heave to on port tack. | Heave to on starboard tack |
| S. E..... | N. E.... | You may heave to on port tack, but in this case the centre will pass very close by; it is better to risk running before the wind N. W. until the wind has shifted to S.W. orW.S.W.,then heave to on starboard tack. | Heave to on starboard tack |
| South... | East .... | Run before the wind to the Northward, or else the center will come too near your vessel; when the wind has shifted to S.W., orW.S.W., heave to on starboard tack. | Heave to on starboard tack |
| S. W.... | S. E..... | Heave to on starboard tack. | Here no shift of wind will take place, as the focus moves away at right angles from the ship. |

*Table showing the different months in the year in which Hurricanes and Cyclones have been recorded in various regions.*

| Locality. | Jan. | Feb. | Mch | Apr. | May | June | July | Aug. | Sept | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North Atlantic and West Indies ..... | 5 | 7 | 11 | 6 | 5 | 10 | 42 | 96 | 80 | 69 | 17 | 7 |
| Southern Indian Ocean, and Mauritius | 9 | 15 | 15 | 8 | 4 | .. | .. | .. | 1 | 1 | 4 | 6 |
| Northern Indian Ocean; Bay of Bengal, N. E. Monsoon..... | 1 | .. | 3 | .. | .. | .. | .. | .. | .. | 12 | 7 | 6 |
| S. W. Monsoon..... | .. | .. | .. | 6 | 16 | 4 | 1 | 2 | 1 | .. | .. | .. |
| Arabian Sea and Bombay, N. E. Monsoon..... | 1 | 1 | 1 | .. | .. | .. | .. | .. | 8 | 12 | 9 | 5 |
| S. W. Monsoon..... | .. | .. | .. | 5 | 9 | 2 | 4 | 5 | .. | .. | .. | .. |
| China Sea and North Pacific, Western part..... | .. | 1 | .. | .. | 2 | 2 | 12 | 5 | 18 | 14 | 12 | 1 |
| Java Sea and Northwest Coast of Australia..... | 3 | 5 | 1 | 1 | 2 | .. | .. | .. | .. | .. | .. | 2 |

### The Thermometer.—Its Uses.

Fahrenheit's Thermometer is used on board ships for the purpose of ascertaining the temperature of the ocean at the surface, and of the air on the ocean.

The Thermometer is a most useful instrument to give warning of the ship's approach to ice in thick, foggy weather. This is known by plunging the Thermometer into a bucket of water, drawn from alongside, at regular intervals during the day, and noting the readings.

In a locality where ice may be expected to be fallen in with, should the mercury in the tube keep sinking, we may conclude that the ship is approaching ice. If it be in the winter season, and the Thermometer has fallen to 34°, she will then be only half a mile from the ice. If in the summer, and the Thermometer has fallen to 42°, she will then be the same distance off. On a nearer approach, the mercury falls still lower. When the ship has passed the ice, the Thermometer again rises. The temperature of the ocean is higher in deep water than in shoal water near the land or on banks. On approaching land, the Thermometer falls from 2° to 6°, except with deep water near a high, bold shore, when the change is not so apparent. The temperature as indicated by the Thermometer is also used in connection with the barometric indications in judging the weather.

### The Barometer.—Barometric Indications.

On board ships the Barometer is relied on for the purpose of foretelling the state of the weather. Confined in a frame is a glass tube containing a column of mercury, which is acted upon by the pressure of the atmosphere; to the frame is attached a scale, marked in inches, and a sliding vernier, the top of which being set at the height of the mercurial column, gives the measurement, in inches and hundredth parts of an inch. In north latitude, it stands highest with N. E. winds, and lowest with S. W. In south latitude, it stands highest with S. E. winds, and lowest with N. W. About the commencement of a storm in north latitude from the S. W., with rain, the Barometer falls, and continues to fall as the storm increases; when it stops and begins to rise, the rain will soon cease, and a shift of wind to the north may be looked for; it may, however, continue to blow hard until the Barometer rises to thirty inches.

In south latitude N. W. winds bring rain, with a fallen Barometer, but it rises with S. winds. It should always be remembered that the state of the air as indicated by the Barometer *foretells coming weather*, rather than shows the present; this invaluable fact is often overlooked. The

longer the time between the barometric signs and the change foretold by them, the longer such altered weather will last; and on the contrary, the less the time between the warning and the change, the shorter will be the continuance of such foretold weather.

The following remarks apply more particularly to northern latitudes: *The Barometer and Thermometer should be noticed in connection.* If the Barometer has been about its ordinary height, say nearly thirty inches (at the sea level), and is steady or rising, while the Thermometer *falls*, and dampness becomes less, N. W., N. or N. E. winds may be expected. On the contrary, if a fall takes place with a *rising* Thermometer, and increased dampness, wind and rain will surely follow from the S. E., S. or S. W. A fall of the Barometer, with a low Thermometer, foretells snow in high latitudes. Exceptions to these rules occur, when a N. E. wind with rain, hail, or snow is impending, before which the Barometer often rises, on account of the coming wind alone; this often deceives persons who expect fine weather from a "rising glass." When the Barometer is rather below its ordinary height, say down to 29.5 inches at sea level, a rise foretells less wind, or a change in its direction towards the northward, or less wet weather; but when it has been very low, say 29 inches, the first rising usually precedes or indicates *strong* winds, and at times heavy squalls from N. W., N. or N. E., after which violence a gradually rising glass foretells an improvement in the weather, if the Thermometer *falls*; but if the warmth continue, the wind will back round more southerly, or southwesterly, and blow, especially if the Barometer rise suddenly. The most dangerous shifts of wind, or the heaviest northerly gales, happen soon after the Barometer rises from a low point, or, at a later period, if the wind veers gradually. Indications of approaching changes of weather, and the direction of winds, are shown less by the height of the Barometer than by its falling or rising. Nevertheless, a height of more than thirty inches (30) is indicative of fine weather, and moderate winds, except from east to north, occasionally. The Barometer is said to be falling when the mercury in the tube is sinking, at which time its upper surface is somewhat concave or hollow, or in Aneroids when the hand moves to the left. The Barometer is rising when the mercurial column is lengthening, the upper surface being then convex or round, or when the hand of the Aneroid moves from left to right. A *rapid rise* of the Barometer always indicates unsettled weather; a slow movement the contrary, as likewise a steady Barometer, which, when continued with dryness of the air, foretells very fine weather. A *rapid* and *considerable fall* foretells stormy weather, rain or snow. *Alternate rising and falling* (sometimes called pumping) indicates very threatening and un-

settled stormy weather. The greatest depressions of the Barometer are with gales from the S. E., S., or S. W. The greatest elevations with wind from N. W., N., or N. E., or with calm. Though the Barometer generally falls with southerly, and rises with northerly winds, the contrary sometimes occurs, in which cases the southerly wind is usually very violent, and accompanied by rain or hail; perhaps with lightning. When a Barometer sinks considerably, much wind, rain or snow will follow, with or without lightning. The wind will be from the northward if the *Thermometer* is low, or from the southward if the Thermometer is high (for the season of the year). A *sudden fall* of the Barometer, with a present westerly wind, will be followed by a violent gale from N. W., N., or N. E. If a gale sets in from the E., or S. E., and the wind veers by the S., the Barometer will continue falling until the wind is near a marked change, when a lull *may* occur, after which the gale will be renewed, perhaps suddenly and violently, and the veering of the wind towards the N. W., N., or N. E., will be indicated by the rising of the Barometer and the falling of the Thermometer.

The Coast Survey reports that N. W. winds on the North Pacific Coast are *not* usually predicted by the Barometer, but from the S. E. almost invariably, the mercury falling one inch from its usual height of thirty inches.

### The Aneroid Barometer.

The indications given by the Aneroid are the same in fact as those by the mercurial column. Its action is governed by atmospheric pressure upon a thin metallic case hermetically sealed, in which has been created a vacuum. The contraction and expansion of this case acts upon a metallic spring, which, connected with certain works, regulates the movements of the hand. The inches and hundredths are read off from the circular scales in the same manner as those of the Mercurial Barometer, the hand indicating the figures. This instrument is very sensitive and exact—and is a safe guide at times when, by the violent motion of the vessel, the plunging of the mercurial column renders the Marine Barometer comparatively useless.

### The Chronometer.

The chronometer is a superior kind of watch, and its advantages for measuring time more accurately are derived from its excellent construction, reduced friction from its peculiar make, and being supplied with a compensation balance, which, when properly adjusted, counteracts the effect of temperature. The reputation of the maker is generally the

only guarantee the purchaser can have for the satisfactory performance of the instrument.

The best position on shipboard for the chronometer, is as near the centre of motion, and as much removed from liability to shocks and change of temperature, as possible. It should be placed in a case firmly secured, resting upon and surrounded by curled hair or other elastic material.

*Magnetism* affects the rates of chronometers. It is, therefore, essential that nothing magnetic be placed near them—the magnetic action of the iron on board vessels is sometimes apt to affect the balance. The principal cause, however, of alteration in the rates of chronometers is change of temperature; to obviate this, some surveying vessels keep the temperature of the chronometer-room equable by means of lamps. The rates do not always change immediately, but sometimes at a considerable interval after the change of climate.

If there is but one chronometer on board, it should never be taken from its place in the cabin, for the purpose of marking time for observations; a watch with a second-hand may be used to mark the time, being compared with the chronometer before and after the observation. If there are more than one, the one moved should be compared, before and after moving, with another, to ascertain whether its rate has been disturbed. It has been found by experience that the motion of a chronometer is frequently accelerated, after being received on board, whereby a gaining rate will be increased and a losing one diminished. This effect has been ascribed to the magnetic action exerted by the iron in the vessel, on the inner rim of the balance, which is made of steel. When the rate has been accelerated, the longitude resulting from observations made with it will be to the westward of the true longitude; when retarded, to the eastward. The *stay* should always be carefully set before moving a chronometer, as they are often injured by neglect of this precaution. It should be wound up at a regular hour each morning, so that the same parts may undergo the same constant action. The rate generally changes after a chronometer has been allowed to run down. After winding, always look at the face to see that it has not stopped, and also at the index, to be certain that it is *wound up;* for it is not uncommon for careless or inexperienced persons to turn the ratchet-key the wrong way, leaving the chronometer unwound. When a chronometer is wound, after running down, it is set going by giving it a small horizontal rotary motion—first taking the precaution to set the *stay.* Chronometers are sometimes liable to jump one or two seconds in the daily rate without any apparent cause (but generally from a defect in the adjustment of the escapement), and then resume their former rate

in a few days; they should be compared or rated at every port where reliable opportunity may offer.

### The Greenwich Date.

Much needless confusion has been produced by the introduction into treatises on Navigation of three distinct modes of reckoning time, viz: Sea, Civil, and Astronomical Account. The *Civil day* begins at midnight and ends the following midnight; the first twelve hours are marked A. M., the last twelve hours P. M. The *Astronomical day* begins at noon, twelve hours after the Civil day commences; the hours are numbered from one to twenty-four, in numerical succession. The use of Sea Account, being productive of much inconvenience, has been abandoned in the U. S. Navy. All the calculations of the Nautical Almanac are adapted to *Astronomical* time at *Greenwich;* it consequently becomes necessary to know the *Greenwich date* (Greenwich date is adopted as expressing both day and hour) or *Astronomical day and hour at Greenwich*, when the observation was taken. The Greenwich date is always given in *mean time*, except the contrary is expressed.

The rule for turning Civil into Astronomical time is: "If the Civil time be A. M., take one from the date and add twelve to the hours, and the result will be the Astronomical time wanted; if the Civil time is marked P. M., discard the designation P. M., and the Astronomical time is had without further change." Thus, January 2d, four hours, A. M., Civil time, is January 1st, sixteen hours, Astronomical day; and January 2d, four hours, P. M., Civil day, is January 2d, four hours, Astronomical day.

#### TO FIND THE GREENWICH DATE WITHOUT THE CHRONOMETER.

In *West longitude* find the Astronomical date and *add* it to the longitude in time; if the sum exceed 24 hours, deduct 24 hours and reckon the time the *next* day.

*Example* 1.

Required the Greenwich date, June 1st, 9 h. A. M., Civil time, in longitude 76° 30′ W.

| | H. | M. | |
|---|---|---|---|
| Civil time, June 1st | 09 | 00 | A.M. |
| Add | 12 | 00 | |
| Astronomical date, May 31 | 21 | 00 | |
| Longitude 76° 30′ W. in time, add | 5 | 06 | |
| | 26 | 06 | |
| Subtract | 24 | 00 | |
| Gives Greenwich date, June 1st | 2 | 06 | |

*Example* 2.

Required Greenwich date, June 1st, 9 h. P.M., Civil time, in longitude 76° 30′ W.

In this case, P.M., Civil date, is—

| | H. | M. |
|---|---|---|
| Astronomical date, June 1st | 09 | 00 |
| Longitude 76° 30′ W. in time, add | 05 | 06 |
| Gives Greenwich date, June 1st | 14 | 06 |

In *East longitude*, from the Astronomical date *subtract* the longitude in time; if the longitude in time be *greater* than the Astronomical date, *add* 24 hours to the latter and reckon it the *preceding* day.

*Example* 1.

Required Greenwich date, May 15th, 7 A.M., Civil time, in longitude 67° 30 E.

| | H. | M. |
|---|---|---|
| Astronomical date is, May 14th | 19 | 00 |
| Longitude 67° 30′ E. in time, subtract | 4 | 30 |
| Gives Greenwich date, May 14th | 14 | 30 |

*Example* 2.

Required Greenwich date, October 1st, 3 hours 45 minutes P.M., Civil time, longitude 110° E.

| | H. | M. |
|---|---|---|
| Astronomical date, October 1st | 03 | 45 |
| Add | 24 | 00 |
| | 27 | 45 |
| Longitude 110° E. in time, subtract | 7 | 20 |
| Gives Greenwich date, September 30th | 20 | 25 |

*When it is noon at the Place.*—In West longitude, the *Greenwich date* is the longitude in *time;* in East longitude, *subtract* the longitude in time from 24 hours, the remainder is the Greenwich date the *preceding* day.

*Greenwich date*, by the methods which have been given, will show whether the Chronometer is A.M. or P.M., viz.:

If the Greenwich date (or Astronomical time) be *less* than 12 hours, the Chronometer shows P.M., but if *more* than 12 hours, the excess is so much past midnight, or A.M.

### Of the Gain and Loss of Time in Circumnavigating the Globe.

A ship sailing *east* or *west* from any meridian, and returning to that meridian after having circumnavigated the globe, will be found to have *gained* or *lost* twenty-four hours of time.

Thus, sailing *west*, say from the meridian of Greenwich, when the ship has made 15 deg. of longitude, the *mean time* will be found to be one hour *behind* that of the Greenwich *chronometer time;* continuing her course west until she reaches the longitude of 180 deg. west, she will have *lost twelve hours;* still proceeding westward, she is now in *east* longitude, and the longitude is decreasing; when she again arrives at the meridian of Greenwich, she will be *twenty-four hours behind time*, or have lost *one entire day*. Hence, when crossing the meridian of 180 deg. west, *one day* must be *discarded*. Thus: should we pass 180 deg. west on *Sunday*, *January* 5*th*, the *next* day must be called *Tuesday*, *January* 7*th*.

When sailing *east* under like circumstances, when 15 deg. of longitude have been made, the mean time at ship will be one hour *ahead* of Greenwich chronometer time. When arrived at 180 deg. *east*, the time at ship will be twelve hours in *advance* of the chronometer. Passing the meridian of 180 deg. east in west longitude, and continuing eastward, we decrease our longitude, until having arrived again at the meridian of Greenwich, we find that we have *gained twenty-four hours* on the voyage.

Hence, when coming to 180 deg. east and crossing to west longitude, *one day* must be counted *twice*. Thus: should we pass the meridian of 180 deg. east on *Sunday*, *January* 5*th*, the *next* day must likewise be called *Sunday*, *January* 5*th*.

### To find the Longitude by Chronometer at Noon, from Equal Altitudes from the Sun.

A. M.—Observe an altitude of the Sun about thirty minutes from noon; note the altitude and time of observation by chronometer.

P. M.—Clamp the index of the sextant or quadrant at the same altitude as observed before noon, and when the Sun falls to it, again note the time by chronometer.

Add together these two chronometer times and find half their sum; to this half-sum apply the chronometer error as usual; the result will be the *mean Greenwich time;* to this Greenwich time apply the equation of time corrected the *contrary way*, as indicated in the "Nautical Almanac," and the product will be the Greenwich *apparent time*, which in *West longitude* is the longitude in time at *apparent noon*, corresponding to the time at which the meridian observation is taken for latitude.

*Example.*

April 20th, 1877 (Civil day). Before noon the altitude of the Sun's lower limb was observed to be 67 deg. 58 min.; time by chronometer, 8 h. 19 m. 15 s. When the Sun fell to the same altitude after noon, the time by chronometer was 9 h. 23 m. 21 s—chronometer slow, 2 m. 15 sec. Required, the longitude.

| | | | | | |
|---|---|---|---|---|---|
| | | | | H. M. | |
| Approximate Greenwich date, April 20th | | | | 9 00 | |
| | H. | M. | S. | | S. |
| A.M. Time by Chronom. | 8 | 19 | 15 | Hourly diff. of Equation.. | 0.53 |
| P.M. Time by Chronom. | 9 | 23 | 21 | Greenwich hours..... | 9 |
| Sum..... | 17 | 42 | 36 | Correction of Equation.. | 4.77 |
| | | | | M. | S. |
| Half-sum ..... | 8 | 51 | 18 | Equation Naut. Alm'c.... | 1 10.7 |
| Chronometer slow, add... | | 2 | 15 | Equa. increasing add..... | 4.8 |
| Greenwich Mean Time... | 8 | 53 | 33 | Corrected Equation..... | 1 15 5 |
| Equation of Time directed *subtract*, hence *add*, being applied to mean time. | | 1 | 15 | | |
| Greenwich apparent time at apparent noon at ship, and is the longitude in time..... | 8 | 54 | 48 | =133° 42′ 00 West longitude. | |

In *East* longitude, the *difference* between *apparent* noon at the ship and the Greenwich time by chronometer, reduced to *apparent time*, is the longitude in time.

*Example.*

April 4th, 1877. Before noon the altitude of the Sun's lower limb was observed to be 86 deg. 10 min.; time by chronometer, 1 h. 50 m. 0 s. When the Sun fell to the same altitude after noon, the time by chronometer was 2 h. 16 m. 0 s. Chronometer fast, 1 m. 10 s. Required the longitude.

| | | | | | |
|---|---|---|---|---|---|
| | | | | H. M. | |
| Approximate Greenwich date April 3d | | | | 14 00 | |
| | H. | M. | S. | | S. |
| A.M. Time by Chronom. | 1 | 50 | 00 | Hourly diff. of Equation. | 0.74 |
| P.M. Time by Chronom. | 2 | 16 | 00 | Greenwich hours..... | 14 |
| Sum..... | 4 | 06 | 00 | | 2.96 |
| Half-sum..... | 2 | 03 | 00 | | 7.4 |
| | | | | Correction of Equation... | 10.36 |
| Chronom. fast, subtract.. | | 1 | 10 | | |

| | | | | M. | S |
|---|---|---|---|---|---|
| Greenwich Mean Time... | 2 01 50 | | Equation Naut. Alm'c.... | 2 | 57.9 |
| Equation of time, directed *add*, hence *subtract*, being applied to mean time | 2 47 | | Equa. *decreasing*, subtract | | 10.4 |
| | | | Corrected Equation..... | 2 | 47.5 |
| Greenwich apparent time | 1 59 03 | | | | |
| Apparent noon at ship... | 12 00 00 | | | | |

Difference in long. in time 10 00 57=150° 14′ 15″ East longitude.

NOTE.—When a ship is making much northing or southing in the interval between the altitudes, if sailing *toward* the Sun, after having noted the chronometer time, *increase* the A. M. altitude by advancing the index of the instrument equal to the difference of latitude made in the interval; sailing *from* the Sun, *decrease* the A.M. altitude by moving the index back, equal to the difference of latitude made in the interval, noting the time for the same altitude P.M. without further correction.

## To Find the Apparent Time and Longitude by Chronometer at Sunrise and Sunset.

RULE.

Observe with a spy-glass the instant the upper or lower limb of the Sun touches the horizon, and note the time by the chronometer.

Bring the latitude forward to the time of observation, correct the declination, and find the Polar distance, as in ordinary cases.

When the *lower limb* is observed, take the *difference* between the Sun's semi-diameter (N. A.) and the refraction, (Table XII, Bowditch) for 00° 00′ alt., from which *subtract* the parallax for 00° 00′ alt., (Table XIV, Bowditch). To this *add* the dip of the horizon (Table XIII, Bowditch) corresponding to the height of the eye above the sea level. The result constitutes a correction, usually about 22′, which must be *subtracted* from the sum of the latitude and Polar distance, and *added* to the half-sum.

When the *upper limb* is observed, *add* together the refraction *less* the parallax, the Sun's semi-diameter, and the dip of the horizon. This correction is usually about 54′, and is also *subtracted* from the sum of the latitude and Polar distance, and *added* to the half-sum.

The *apparent time* is found by the rule given on page 208 (Bowditch), for working the time by the tables, and the *longitude* by turning the difference between this time and the Greenwich date into degrees and minutes; except great accuracy is required, the application of 22′ as a correction for the Sun's *lower* limb, and 54′ for the *upper*, *subtracted* and *added* as above directed, will give an approximate result.

*Example.*

December 10th, 1877. Civil time, in latitude 42° 00′ north, and longitude 135° 00′ west, the Sun's *lower* limb was observed to set at 4 h. 30 m. P.M. Time by chronometer, 1 h. 30 m. 00 s.; error, 4 m. 00 s. fast; height of eye, 30 feet. Required the apparent time and longitude.

| | | |
|---|---|---|
| | H. M. S. | |
| Refraction..... 33 00 | App. time of obs... 4 30 00 | Hourly diff. declination... 13.0 |
| Sun's S. D..... 16 17 | Long. 135° West, in time, add... 9 00 00 | Greenwich hours and parts..... 13.5 |
| 16 43 | Greenwich date.. 13 30 00 | 650 |
| Parallax..... 9 | Declination... 22° 58′ 01″ S. | 390 |
| 16 34 | Increasing, add cor. 2 55 | 130 |
| Dip (add)..... 5 23 | Correct declin'n. 23 00 56 | 60) 175.50 |
| Correction..... 21 57 | 90 | Cor. of declination.... 2′ 55″.5 |
| | Polar distance. 113 00 56 | |

| | | |
|---|---|---|
| | | S. |
| Sun's altitude..... 00 00 | | Hourly difference, equation 1.15 |
| Latitude..... 42 00 | secant.. 0.12893 | Greenwich hours and parts 13.5 |
| Polar distance..... 113 01 | co-secant 0.03603 | 575 |
| Sum..... 155 01 | | 345 |
| Correction..... — 22 | | 115 |
| 154 39 | | Correction..... 15.525 |
| Half-sum..... 77 20 | co-sine.. 9.34100 | M. S. |
| Correction, add..... 22 | | Equation..... 6 52.0 |
| 77 42 | sine..... 9.98991 | Decreasing, subtract.... 15.5 |
| | 19.49587 | Corrected equation..... 6 36.5 |
| H. M. S. | 9.74793 | =4 h. 32 m. 16 s. apparent time. |
| Time by chro.. .... 1 30 00 | | 6 36.5 equa., subtract |
| Chro. fast, subtract. 4 00 | | 4 25 39.5 Mean time. |
| 1 26 00 | | |
| Add.....12 00 00 | | |
| Greenwich mean time..... 13 26 00 | | |
| Time at ship..... 4 25 39 | | |
| Long. in time..... 9 00 21 | =135° 05′ 15″ West longitude. | |

**To find the Sun's Declination from the Nautical Almanac.**

Find the Greenwich date; take from the "Nautical Almanac" the declination for apparent noon and the hourly difference. If the declination is increasing, mark the difference + *add*; if decreasing — *subtract*; reduce the time to hours and decimal parts of an hour, and multiply the hourly difference by it; reduce the product to minutes and seconds, and *add* it to or *subtract* it from the declination at noon, as indicated by the sign.

*Example* 1.

Required, the Sun's declination, at noon, November 6th, 1877, in longitude 153° 47′ West.

| | H. | M. |
|---|---|---|
| Local Astronomical date is November 6th | 00 | 00 |
| Longitude 153° 45′ West, in time, add | 10 | 15 |
| Greenwich date is November 6th | 10 | 15 |

| | | | ° | ′ | ″ |
|---|---|---|---|---|---|
| Hourly difference | 44.″8 | Sun's declination | 16 | 06 | 42 |
| Hours, Greenwich time, and decimal parts | 10.25 | Declinat'n, increasing, add | | 7 | 39 |
| | 2240 | Required declination | 16 | 14 | 21 |
| | 896 | | | | |
| | 448 | | | | |
| | 60)459.200 | | | | |
| | 7′39″.2 | | | | |

*Example* 2.

Required, the Sun's declination, January 9th, 1877, at 9 A. M., in longitude 97° 08′ East.

| | H. | M. |
|---|---|---|
| Local Astronomical date is January 8th | 21 | 00 |
| Longitude 97° 08′ East, in time, subtract | 6 | 30 |
| Greenwich date is January 8th | 14 | 30 |

| | | | ° | ′ | ″ |
|---|---|---|---|---|---|
| Hourly difference | 20.″7 | Sun's declination | 22 | 11 | 35 |
| Hours, Greenwich time, and decimal parts | 14.5 | Declination decreasing, subtract | | 5 | 00 |
| | 1020 | Required declination | 22 | 06 | 35 |
| | 828 | | | | |
| | 207 | | | | |
| | 60)300.00 | | | | |
| | 5′00″ | | | | |

NOTE.—In these examples, as in all other cases, the hourly difference being in seconds, with a decimal fraction, renders it necessary that, when multiplied by the hours and minutes of time, these minutes should also be reduced to decimals of an hour. Vulgar fractions are turned into decimal fractions by dividing the numerator by the denominator, thus 15 minutes being 15 sixtieths of an hour, 15 divided by 60 gives .25 for the decimal fraction; and again, in like manner, 6 h. 30 min. is equal 6.5 hours.

## MEAN TIME OF TRANSIT OF THE POLE STAR OVER THE MERIDIAN.

*Also, the Eastern and Western Elongations for every Tenth Day in* 1877, *Calculated for the Longitude of San Francisco.*

| 1877. | Upper Transit. Evening. | 1877. | Upper Transit. Morning. | 1877. | Western Elongation. Morning. | 1877. | Eastern Elongation. Morning. |
|---|---|---|---|---|---|---|---|
| | H. M. S. | | H. M. S. | | H. M. S. | | H. M. S. |
| Jan. 1 | 6 26 9 | June 29 | 6 42 13 | Jan. 1 | 0 21 14 | July 9 | 0 4 3 |
| Jan. 10 | 5 50 37 | July 9 | 6 3 4 | | evening | | evening |
| | Low. Tran. | July 19 | 5 23 54 | Jan. 10 | 11 49 38 | July 19 | 11 20 57 |
| | morning | July 29 | 4 44 44 | Jan. 20 | 11 10 10 | July 29 | 10 41 47 |
| Jan. 20 | 5 13 7 | Aug. 8 | 4 5 34 | Jan. 30 | 10 30 43 | Aug. 8 | 10 2 37 |
| Jan. 30 | 4 33 40 | Aug. 18 | 3 26 23 | Feb. 9 | 9 51 15 | Aug. 18 | 9 23 26 |
| Feb. 9 | 3 54 12 | Aug. 28 | 2 47 11 | Feb. 19 | 9 11 48 | Aug. 28 | 8 44 14 |
| Feb. 19 | 3 14 45 | Sept. 7 | 2 7 58 | Mar. 1 | 8 32 23 | Sept. 7 | 8 5 1 |
| Mar. 1 | 2 35 20 | Sept. 17 | 1 28 44 | Mar. 11 | 7 52 59 | Sept. 17 | 7 25 47 |
| Mar. 11 | 1 55 56 | Sept. 27 | 0 49 29 | Mar. 21 | 7 13 37 | Sept. 27 | 6 46 32 |
| Mar. 21 | 1 16 34 | Oct. 7 | 0 10 12 | Mar. 31 | 6 34 15 | Oct. 7 | 6 7 15 |
| Mar. 31 | 0 37 12 | | evening | April 10 | 5 51 1 | | West. elong. |
| | evening | Oct. 17 | 11 26 58 | | East. elong. | | morning |
| April 10 | 11 53 58 | Oct. 27 | 10 47 39 | | morning | Oct. 17 | 5 29 55 |
| April 20 | 11 14 41 | Nov. 6 | 10 8 18 | April 20 | 5 17 38 | Oct. 27 | 4 50 36 |
| April 30 | 10 35 26 | Nov. 16 | 9 28 55 | April 30 | 4 38 23 | Nov. 6 | 4 11 15 |
| May 10 | 9 56 11 | Nov. 26 | 8 49 31 | May 10 | 3 59 8 | Nov. 16 | 3 31 52 |
| May 20 | 9 16 58 | Dec. 6 | 8 10 6 | May 20 | 3 19 55 | Nov. 26 | 2 52 28 |
| May 30 | 8 37 47 | Dec. 16 | 7 30 40 | May 30 | 2 40 44 | Dec. 6 | 2 13 3 |
| June 9 | 7 58 36 | Dec. 26 | 6 51 13 | June 9 | 2 1 33 | Dec. 16 | 1 33 37 |
| June 19 | 7 19 26 | Dec. 31 | 6 31 29 | June 19 | 1 22 23 | Dec. 26 | 0 54 10 |
| | | | | June 29 | 0 43 12 | Dec. 31 | 0 34 26 |

The times for the intermediate days can readily be found by proportion. The Pole Star is so slow moving that if an observation taken, be within ten or fifteen minutes of the time given, the error in latitude will be trifling. If the place of observation be not on the meridian of San Francisco, to the times given, add 9.8 seconds for every fifteen degrees, or one hour of longitude if to the west of San Francisco, or subtract if to the east. For examples, in finding latitude by means of the above table, see next page.

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## To Find the Latitude by the Pole Star.

During the year 1877, the declination of the Pole Star at its Upper Transit will be 88° 39′ North, at its Lower Transit 91° 21′, and at each Elongation 90°.

In observations for latitude: after finding the altitude, subtract the proper correction for dip and refraction (generally 5 minutes); then, if the star is passing the Upper Transit, subtract the complement of the declination (that is, the difference between it and 90° = 1° 21′), and the result is the latitude required.

If the star is passing its Lower Transit, add 1° 21′, with like result.

If the star is at either of its elongations, no other corrections are to be applied than those for dip and refraction.

*Examples.*

I.—On the 10th January, 1877, at 5 h. 51 m. P.M., San Francisco time, the observed altitude of the Pole Star at the Upper Transit was 47° 47′; height of the observer 18 feet; required the latitude.

II.—On the 30th May, 1877, at 8 h. 38 m. P. M., the observed altitude of the Pole Star at the Lower Transit was 54° 20′; height of the observer 10 feet; required the latitude.

III.—On the 27th October, 1877, at 4 h. 51 m. A, M., the observed altitude of the Pole Star at the Western Elongation was 26° 15′; height of the observer 26 feet; required the latitude.

| I. | ° | ′ |
|---|---|---|
| Observed altitude | 47 | 47 |
| Subtract dip 4′, refr. 1′ | | 5 |
| True altitude | 47 | 42 |
| Subtract comp. of dec | 1 | 21 |
| Latitude | 46 | 21 |

| II. | ° | ′ |
|---|---|---|
| Observed altitude | 54 | 20 |
| Subtract dip 4′, refr. 1′ | | 5 |
| True altitude | 54 | 15 |
| Add comp. of dec | 1 | 21 |
| Latitude | 55 | 36 |

III.

| | ° | ′ |
|---|---|---|
| Observed altitude | 26 | 15 |
| Subtract dip 5′, refr. 2′ | | 7 |
| True altitude | 26 | 08 |

And is also the latitude.

### The Equation of Time.

Find the Greenwich date; take the equation of time, and hourly difference, from the "Nautical Almanac;" reduce the time to hours and decimal parts, and multiply the hourly difference by it; *add* the product if the equation is *increasing; subtract* if *decreasing.*

Required, Equation of time corresponding to date and longitude given in Example 1, for finding the Sun's declination:

| | | | H. M. |
|---|---|---|---|
| Greenwich date, November 6th, 1877, is | | | 10 15 |
| | S. | | M. S. |
| Hourly difference | 0.13 | Equation of time | 16 14.7 |
| Hours, Greenwich time, and decimal parts | 10.25 | Equation decreasing, subtract correction | 1.3 |
| | 65 | Equation required | 16 13.4 |
| | 26 | To be subtracted from apparent time. | |
| | 13 | | |
| | 1.3325 | | |

Required, Equation of time corresponding to date and longitude given in Example 2, for finding the Sun's declination:

| | | | H. M. |
|---|---|---|---|
| Greenwich date, January 8th, 1877, is | | | 14 30 |
| | S. | | M. S. |
| Hourly difference | 1.05 | Equation of time | 7 07.9 |
| Hours, Greenwich time, and decimal parts | 14.5 | Equation increasing, add correction | 15.2 |
| | 525 | Equation required | 7 23.1 |
| | 420 | To be added to apparent time. | |
| | 105 | | |
| | 15.225 | | |

## ADDENDUM.

Captain Peterson, of the schooner *Ada May*, reports a breaker in latitude 37 deg. 50 min. north, longitude 128 deg. 22 min. west. The sea was smooth, and a heavy swell from the west met by an easterly wind caused a heavy breaker, indicating shoal water. His chronometer was correct on reaching San Francisco, December 20th, 1876.

## CIRCULAR RELATIVE TO FOG SIGNALS.

The following Rules, amendatory to Article 15, governing Fog Signals, on page 80 of this work, have lately been issued from the Treasury Department at Washington:

1. Whenever there is a fog by day or night, the fog signals described below shall be sounded.

2. Sailing vessels, and every craft propelled by sails upon the ocean, lakes, and rivers, shall, when on the starboard tack, sound one blast of their fog-horns; when on the port tack, they shall sound two blasts of their fog-horns; when with the wind free or running large, they shall sound three blasts of their fog-horns; when lying-to or at anchor, they shall sound a general alarm. In each instance, the above signals shall be sounded at intervals of not more than two minutes.

3. Sailing vessels when not under way, and anchored or moored in the channel or fairway of commerce, shall sound the general alarm signal at intervals of not more than two minutes, and all steamers navigating in a fog or thick weather, shall, by the rules governing pilots, sound their steam whistles at intervals of not more than one minute.

4. Sailing vessels shall at all times, on the approach of any steamer, during the night-time, show a lighted torch upon that point or quarter to which such steamer shall be approaching. And upon any craft navigating rivers without being in tow of a steamer, such as rafts, flat-boats, wood-boats, and other like craft, they shall sound a fog-horn at intervals of not more than two minutes.

5. It shall at all times be the duty of steamers to give to the sailing vessel, or other craft propelled by sails, every advantage, and to keep out of her way.

WM. A. RICHARDSON,
Secretary of the Treasury.

## Rain-fall in San Francisco, Cal. (1849 to 1876), as Recorded by Thomas Tennent.

### FROM 1849 TO 1862.

| | 1849. | | 1850. | | 1851. | | 1852. | | 1853. | | 1854. | | 1855. | | 1856. | | 1857. | | 1858. | | 1859. | | 1860. | | 1861. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. | Quantity. | Days. |
| July | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | .02 | 1 | ..... | .. | .05 | 2 | ..... | .. | .21 | 1 | .... | .. |
| August | .. .. | .. | ..... | .. | ..... | .. | ..... | .. | .04 | 1 | .01 | 1 | ..... | .. | ..... | .. | .05 | 2 | .16 | 2 | .02 | 1 | ..... | .. | ..... | .. |
| September | ..... | .. | 0.33 | 4 | 1.03 | 1 | ..... | .. | .46 | 4 | .15 | 3 | ..... | .. | .07 | 2 | ..... | .. | ..... | .. | .03 | 1 | ..... | .. | .02 | 1 |
| October | 3.14 | 3 | ..... | .. | .21 | 2 | .80 | 1 | .12 | 2 | 2.41 | 9 | ..... | .. | .45 | 5 | .93 | 3 | 2.74 | 4 | .05 | 1 | .91 | 12 | ..... | .. |
| November | 8.66 | 8 | .92 | 7 | 2.12 | 5 | 5.31 | 12 | 2.28 | 12 | .34 | 2 | .67 | 7 | 2.79 | 9 | 3.01 | 11 | .69 | 5 | 7.28 | 15 | .58 | 3 | 4.10 | 12 |
| December | 6.20 | 12 | 1.05 | 4 | 7.10 | 14 | 13.20 | 20 | 2.32 | 11 | .81 | 3 | 5.76 | 15 | 3.75 | 12 | 4.14 | 8 | 6.14 | 14 | 1.57 | 6 | 6.16 | 21 | 9.54 | 16 |
| | **1850.** | | **1851.** | | **1852.** | | **1853.** | | **1854.** | | **1855.** | | **1856.** | | **1857.** | | **1858.** | | **1859.** | | **1860.** | | **1861.** | | **1862.** | |
| January | 8.34 | 15 | .72 | 5 | .58 | 4 | 3.92 | 11 | 3.88 | 10 | 3.67 | 11 | 9.40 | 13 | 2.45 | 7 | 4.36 | 8 | 1.28 | 4 | 1.64 | 8 | 2.47 | 8 | 24.36 | 18 |
| February | 1.77 | 5 | .54 | 4 | .14 | 4 | 1.42 | 5 | 8.04 | 16 | 4.77 | 10 | .50 | 4 | 8.59 | 15 | 1.83 | 8 | 6.32 | 18 | 1.60 | 7 | 3.72 | 8 | 7.53 | 10 |
| March | 4.53 | 7 | 1.94 | 9 | 6.68 | 14 | 4.86 | 6 | 3.51 | 11 | 4.64 | 12 | 1.60 | 5 | 1.62 | 6 | 5.55 | 8 | 3.02 | 11 | 3.99 | 13 | 4.08 | 8 | 2.20 | 11 |
| April | .46 | 3 | 1.23 | 8 | .26 | 3 | 5.37 | 8 | 3.12 | 9 | 5.00 | 10 | 2.94 | 6 | ..... | .. | 1.55 | 4 | .27 | 4 | 3.14 | 8 | .51 | 4 | .73 | 9 |
| May | ..... | .. | .67 | 3 | .32 | 1 | .38 | 7 | .02 | 1 | 1.88 | 6 | .76 | 3 | .02 | 3 | .34 | 3 | 1.55 | 4 | 2.86 | 11 | 1.00 | 3 | .74 | 5 |
| June | ..... | .. | ..... | .. | ..... | .. | ..... | .. | .08 | 2 | ..... | .. | .03 | 1 | .12 | 1 | .05 | 1 | ..... | .. | .09 | 2 | .08 | 2 | .65 | 1 |
| | 33.10 | 53 | 7.40 | 44 | 18.44 | 48 | 35.26 | 70 | 23.87 | 79 | 23.68 | 67 | 21.66 | 54 | 19.81 | 61 | 21.88 | 56 | 22.22 | 68 | 22.27 | 73 | 19.72 | 70 | 49.27 | 83 |

Rain Gauges complete, with instructions, $12. Made and for sale by Thomas Tennent, No. 18 Market Street.

## Rain-fall in San Francisco, Cal. (1849 to 1876), as Recorded by Thomas Tennent.

### FROM 1862 TO 1876.

| | 1862. | | 1863. | | 1864. | | 865. | | 1866. | | 1867. | | 1868. | | 1869. | | 1870. | | 1871. | | 1872. | | 1873. | | 1874. | | 1875. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* | *Quantity.* | *Days.* |
| July | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | 0.03 | 2 | ..... | .. | ..... | .. |
| August | ..... | .. | ..... | .. | .21 | 3 | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | ..... | .. | 0.15 | 3 | ..... | .. | ..... | .. |
| September | ..... | .. | .03 | 1 | .01 | 1 | .24 | 2 | .11 | 2 | .04 | 1 | ..... | .. | .12 | 1 | .03 | 1 | .03 | 2 | 0.14 | 1 | ..... | .. | 0.08 | 2 | ..... | .. |
| October | .40 | 2 | ..... | .. | .13 | 3 | .26 | 4 | ..... | .. | .20 | 1 | .15 | 3 | 1.29 | 2 | ..... | .. | .11 | 2 | 0.21 | 1 | 0.68 | 2 | 2.73 | 8 | 0.22 | 2 |
| November | .15 | 3 | 2.55 | 5 | 6.68 | 8 | 4.19 | 10 | 3.35 | 12 | 3.41 | 6 | 1.18 | 5 | 1.19 | 5 | .43 | 4 | 3.72 | 9 | 2.62 | 3 | 1.31 | 6 | 5.92 | 7 | 6.73 | 15 |
| December | 2.35 | 9 | 1.80 | 8 | 8.91 | 18 | .58 | 8 | 15.16 | 18 | 10.69 | 18 | 4.34 | 11 | 4.31 | 7 | 3.38 | 8 | 16.74 | 14 | 7.25 | 10 | 10.12 | 20 | 0.28 | 4 | 3.08 | 10 |
| | **1863.** | | **1864.** | | **1865** | | **1866.** | | **1867.** | | **1868.** | | **1869.** | | **1870.** | | **1871.** | | **1872.** | | **1873.** | | **1874.** | | **1875.** | | **1876.** | |
| January | 3.63 | 9 | 1.83 | 5 | 5.14 | 9 | 10.88 | 16 | 5.16 | 15 | 9.50 | 17 | 6.35 | 14 | 3.89 | 9 | 3.07 | 7 | 4.22 | 10 | 2.17 | 8 | 4.85 | 14 | 6.97 | 11 | 6.41 | 14 |
| February | 3.19 | 10 | ..... | .. | 1.34 | 8 | 2.12 | 9 | 7.20 | 9 | 6.13 | 9 | 3.90 | 5 | 4.78 | 9 | 3.76 | 10 | 6.97 | 20 | 4.24 | 17 | 1.83 | 10 | 0.20 | 1 | 3.96 | 7 |
| March | 2.06 | 8 | 1.52 | 9 | .74 | 4 | 3.04 | 12 | 1.58 | 7 | 6.30 | 12 | 3.14 | 12 | 2.00 | 8 | 1.29 | 8 | 1.64 | 10 | 0.78 | 4 | 3.55 | 15 | 1.08 | 6 | 4.37 | 11 |
| April | 1.61 | 9 | 1.57 | 4 | .94 | 3 | .12 | 1 | 2.36 | 8 | 2.31 | 9 | 2.19 | 5 | 1.53 | 4 | 1.93 | 5 | 1.10 | 7 | 0.52 | 3 | 1.04 | 7 | 0.02 | 1 | 1.04 | 8 |
| May | .23 | 2 | .78 | 5 | .63 | 2 | 1.46 | 6 | ..... | .. | .03 | 2 | .08 | 2 | .20 | 2 | .21 | 3 | .16 | 3 | 0.01 | 1 | 0.34 | 4 | 0.11 | 2 | 0.18 | 1 |
| June | ..... | .. | ..... | .. | ..... | .. | .04 | 1 | ..... | .. | .23 | 3 | .02 | 1 | ..... | .. | ..... | .. | .02 | 2 | 0.08 | 1 | 0.08 | 2 | 1.01 | 3 | 0.02 | 1 |
| | 13.62 | 52 | 10.08 | 37 | 24.73 | 59 | 22.93 | 69 | 34.92 | 71 | 38.84 | 78 | 21.35 | 58 | 19.31 | 47 | 14.10 | 46 | 34.71 | 79 | 18.02 | 49 | 23.98 | 85 | 18.40 | 45 | 26.01 | 69 |

Average Rain-fall from the season of 1849-50 to that of 1875-6—27 seasons—23.8 inches.

# THE

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# $750,000 GOLD!

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Accepted under all approved forms and for all desirable voyages.

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In all the principal cities of the Union.

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The Fire Income of this Company is derived from moderate lines, well distributed, thus avoiding the liability to overwhelming disaster to policy holders and Company attendant upon a HEAVY CONCENTRATION OF HAZARD.

THE OLDEST LOCAL:

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# California Insurance Co.

ORGANIZED FEBRUARY, 1861.

*OFFICE, - - - - 318 CALIFORNIA STREET,*

Three doors east from Sansome, San Francisco.

*CAPITAL PAID UP*.....*$300,000*
*ASSETS, January 1st, 1876*.....*515,000*

C. T. HOPKINS, President. H. B. TICHENOR, Vice-President.
Z. CROWELL, Secretary.
CAPT. D. F. HUTCHINGS, Marine Surveyor, also Veritas Surveyor.

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# COMMERCIAL

# Insurance Company

## OF CALIFORNIA,

# FIRE AND MARINE.

Amount of Capital Stock paid up in Cash.....*$200,000 00*
Total Assets January 1st, 1876..... *448,225 89*
Total Losses paid since the organization of the Company,
February 26, 1872.....*over 400,000 00*

C. W. KELLOGG, President. CHAS. A. LATON, Secretary.

Office.....228 CALIFORNIA STREET, SAN FRANCISCO.

This Company aims to secure the best risks on all desirable hazards, at remunerative rates. Prompt and equitable adjustment and payment of losses.

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# Investment and Insurance Co.

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*Principal Office, 218 and 220 Sansome St., San Francisco.*

OFFICERS—Peter Donahue, President; A. J. Bryant, Vice President; Charles H. Cushing, Secretary.

The business of this Company is confined entirely to the State of California and the Pacific Coast.

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PROPRIETORS:

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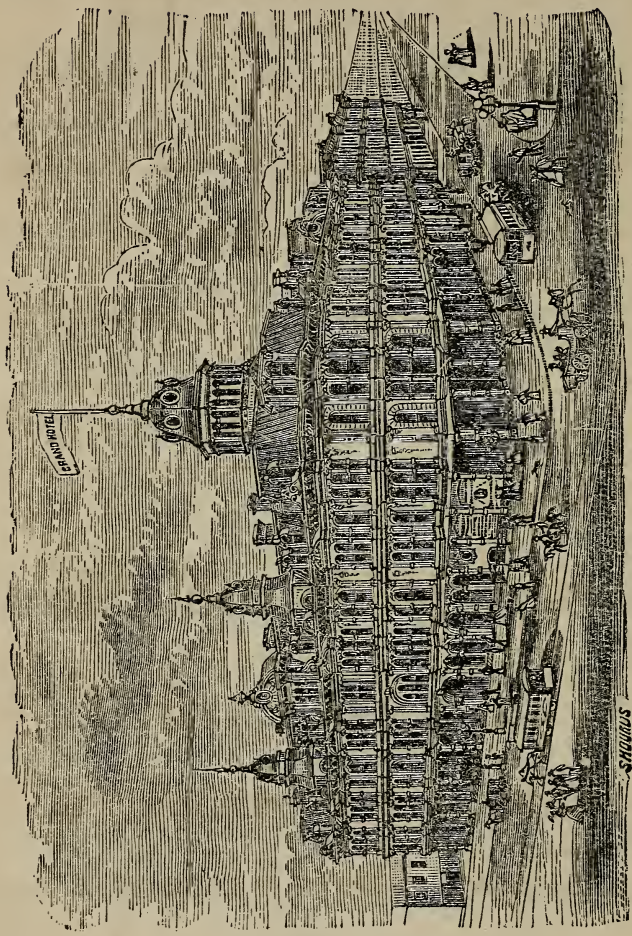


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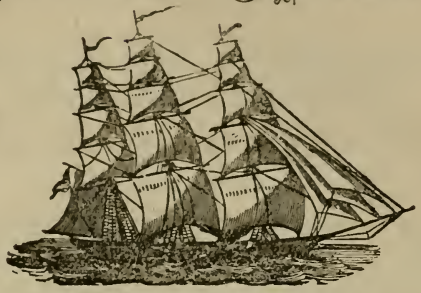

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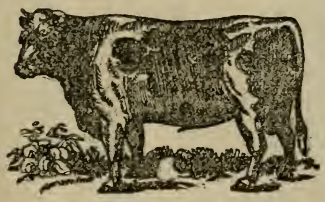

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